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☞ An asterisk (*) denotes an illustrated article

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WISHING TO MAKE THIS JOURNAL an organ of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, the publishers solicit letters from all among them who make the study of these subjects a pleasure, or a profession.

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FIFTH ANNUAL MEETING OF THE AMER. GAS LIGHT ASSOCIATION.

The fifth annual meetinng of the Association will be held at Cincinnati, O., on Wednesday, Oct. 17, 1877. Headquarters will be at the Gibson House on Walnut St. between 4th & 5th where arrangements have been made for the members at special reduced rates per day.

The meetings will be held in Gas Hall, corner of 4th and Plum Sts. Members are requested to prepare papers on any subject connected with ga matters, and to confer with the Secretary con cerning the same. CHAS. NETTLETON, Sec'y., 117 Broadway, New York.

THE CINCINNATI MEETING.

From various sources we hear encouraging accounts as to the probable number of gas engineers who expect to attend the Cincinnati meeting, and we are confident that there will be a large attendance, and that the meeting will be an interesting one. Eveay gas company in the land *ought* to be represented. The Management of a gas company ought to see to it that they are represented, and their agent, engineer, or superintendent should not be allowed to stay away on account of the *expense* of attending it. There is nothing to which gas engineers, as a class, are so liable as to "get into a rut," and the fact that they are so seldom able to leave home, on account of the very nature of their business, makes it exceedingly difficult for them to get out of the rut. The company should see to it that they do get out of the rut at least once a year by attending these meetings. Contact with other men has a wonderful effect in imparting and receiving new ideas.

The manager of a gas works at home is, to a certain extent, "monarch of all he surveys"; but when he goes away from home, and joins in the crowd of other monarchs, they become, for the time being, common people—so to speak. Authority and responsibility are alike thrown aside for the time, and opportunity is given to take a broader and more unbiased view of the field, and to come directly in contact with other minds bent to accomplish similar tasks to their own. The crudest and most impracticable idea of one man may be taken and worked out successfully by another, and the world benefitted thereby. It is useless to attempt to re-enumerate the many benefits of united action in societies of this kind. Those who have attended their meetings know that there is always something to be learned; and, in many instances, the small items of knowledge resulting from getting at the practical experience of others, have resulted, in the aggregate, in immense savings to the companies in a single year. Let every man make his arrangements to go this year and try for himself.

To those members, or others, who intend to go by way of New York, we are happy to announce that tickets, from New York to Cincinnati, at the special rates for which arrangements have been made, can be obtained by applying to the Secretary, before 12 o'clock on Oct. 15th, either by letter or in person.

Gas as Fuel.

Recent activity in the manufacture and sale of gas stoves has led to investigation, somewhat extensive in the matter of the daily use of stoves, furnaces, and apparatus for heating and warming. As we consider, in the problem of power, time, distance, and weight, so should we, in the problem of artificial heat, question the advantage of time, convenience, and comfort.

It will be unnecessary to detail an illustrated comparison of the coal stove or furnace with the gas burner, so far as cleanliness and convenience are concerned, for nearly every one must at once accord to the gas burner its positive superiority. Granting at once that by using a gas apparatus we do away with dust, smoke, ashes, cinders, kindling material, labor, and save time, which is truly money in this instance, we have a strong basis at the outset for commendation; and to fully comprehend the comparative merit of the use of gas as fuel, let us first consider the adaptability of such fuel to summer use. It is desirable to keep as cool during the heated term as is consistent with the pecuniary and mechanical means at our command; therefore, we should have our artificial heat so arranged as to be used only when desired for active work, and employed no longer than is necessary, thus we shall escape uncalled for heating of the house, and incidentally avail ourselves of an instrument of economy. Second, we should engage every sanitary means within our reach to maintain good bodily health, and dispense with the imperfect combustion, always maintained where coal is burned confined. Carbonic oxide (a deadly poison) is given off in large quantities from the imperfect combustion of coal; and even though the damper of the stove or furnace be wide open will escape through the cracks, and even through the iron or brick itself, to permeate the surrounding atmosphere. A

steak broiled over a coal fire is, nine times in ten, saturated through and through with carbonic oxide.

It seems unnecessary to delineate the labor of building and maintaining a coal fire, whether it be during hot or cold weather, as all are sufficiently familiar with this proceeding to render the unanimous decision that it is a veritable nuisance. Why not abate it? and employ gas. If it costs as much again for gas to do the same work it is cheaper, for, surely, the discomfort, labor, loss of time, dirt, etc., dispensed with, is worth one-half the cost of the fuel. But practical observation, and experiment conducted for the past three years, proves to us that not only are we blessed with surroundings calculated to sweeten the temper of mankind, when using a reliable gas stove, but the gas actually used for cooking, and performing all necessary fuel labor, during the warm season, costs no more than the coal and kindling used for the same purposes, and we get the comfort, saving of time, convenience and sanitary influence thrown gratuitously into the trade. Every conceivable form of fuel labor is now provided for in the modern gas stove, and coal, so long considered a necessity in the household, is out of the consideration altogether.

Having settled the question, in our minds, that gas for summer use is eminently better than coal, we proceed to a more extended consideration of its uses and comparisons as applied for warming houses, and for mechanical or other purposes, where heat is required. To maintain a constant heat for twelve or twenty-four hours, a much larger quantity of gas must be consumed than when required for summer household use—thus cancelling the consideration of time from the problem. This makes it a question of relative cost of fuel for the amount of heat constantly being used; and we have nothing to balance the extra cost of gas over coals but its cleanliness and convenience. It is more expensive to run a gas stove, for a given amount of heat, than it is to run a coal stove for the same. Hence, when the heat is to be continuous, the coal stove has the advantage so far as cost is concerned; but would it not be proper for the gas company to look into this matter more diligently, and seek some means of at once engaging a large daily consumption, and, at the same time, bringing the cost of gas for heating purposes within the reach of all.

If gas sold at a given price for illuminating purposes, and the consumption be a given number of cubic feet per twenty-four hours, would it not prove a speculation worthy the steel of any company to set a special meter connected with the heating and cooking apparatus, *and sell gas for these purposes at half price*, the distributing expense would not be materially increased, and the extra low rate, and increased consumption, would demonstrate the utility of gas for fuel, and open a new field for every enterprising gas company.

So strong is the popular demand for gas as fuel that the manufacture of gas stoves is fast becoming one of the industries of our country; it needs but the cordial and sympathetic co-operation of the manufacturers of gas to work a common good to all concerned. When the gas stove manufacturer, the gas company, and the people are hand in hand in their efforts to bring about the use of gas as fuel, then will we realize what should have existed long since—the economical and effective transportation of light and heat to every house within the reach of a gas main.

We rejoice to find companies which manufacture the best stoves are thoroughly alive to the wants of the community, and are putting forth every effort to bring gas into universal use, both as fuel for stationary boilers, cooking, warming, and mechanical purposes.

We are also pleased to learn that quite a large number of manufacturers of gas are putting forth every effort in hearty support.

Gas versus Electricity.

[We take great pleasure in presenting the following letter from the London *Journal of Gas-Lighting* as, in our opinion, it presents the matter in its true light. From all the information we have yet been able to gather, we do not deem it probable that electric lighting is as yet adapted to domestic purposes. When we remember the rapid strides made in electric science since Franklin's kite first gave him a shock, we are perfectly prepared for any new development; but, at this time, we do not feel disposed to admit that gas-light is yet to be superseded by electricity.—Ed.]

Sir—The recent scare among the holders of gas shares is a matter which calls for more serious attention than it seems at present to have received. The capital at this moment invested in this country in gas undertakings represents a sum very little short of eighty millions sterling. Now, for so vast an amount of property to be subject to such rapid depreciation as took place a few days ago on the London Stock Exchange proves one of two things—either that gas proprietors have but little confidence in the stability of the business in which they are engaged, or that they are but imperfectly acquainted with the technicalities of the process in which they have embarked their money. I think the latter is the more universal cause of the panics which every now and then take place among the shareholders in gas property. Let any newspaper writer give a highly colored description of some experiments with a new light, and forthwith a hundred embryo philosophers start up to sound the praises of the new luminary and prognosticate the extinction of the old lights and all their disagreeable accessories; shareholders take fright, and soon become the victims of a host of unscrupulous speculators.

In looking back over a professional career of some forty years, I can distinctly remember a few of these panics. We have had Lime and Electric lights, Bude and Boccius' lights, Paynes', White's, Mongruel's, Patent, New, Air, and Eupion gas, and now we are to have another new light, in the shape of the "electric candles." Surely, after sixty years experience, the proprietors of gas works should be acquainted with the practical details of their business, and ought to be so far posted up in the progress of science as to be able to judge of the value of any process submitted for public approval, and thus either accept the new discovery as an improvement on their old mode of working, or else show their confidence in their proceedings by maintaining the value of their property, and not scamper off like flocks of frightened sheep when they hear some one trying to play an old tune on what appears to be a new instrument.

What are the facts connected with the so-called "electric candle" that prove it to be more applicable for domestic lighting than any previous form of electric light? It is true the adjustment of the carbon points may secure greater permanency in the light itself; it may also be true that the magneto-electric apparatus is more perfect, and, therefore, the cost of producing the electric current greatly reduced, but the light obtained from such a source will always remain one of intensity, and not one of quantity, and hence it must be a light only adapted for situations where great penetrating power is requisite. We hear of electric lamps of 100, 200, 300, and 400 gaslight power. I have recently seen some of these lamps, and I have no hesitation in affirming that, for all manufacturing purposes involving any ordinary amount of manipulative skill, for halls and public assemblies, for shops and stores, and especially for rooms in private houses, such lights are totally useless, unless the intensity of the light is modified and subdued by the intervention of screens, diaphragms, reflectors, or some mechanical arrangements to render the light more diffusive. Only those who have experimented with the lights of intensity are able to judge of the great difficulty there is in rendering such a mode of illumination available for ordinary purposes.

I cannot better illustrate the position these lights bear to the light furnished by gas, oil lamps, candles, etc., than by taking the action of a powerful locomotive on one of our great railways. This mechanical horse drags a load of 500 or 600 tons with a speed and regularity perfectly unattainable by the expenditure of any amount of animal power; it does its work effectively and economically; but suppose the same machine were put to do the work that could easily be performed by a couple or three horses, it is perfectly clear the cost of doing such work by the engine would be out of all proportion to the results obtained. Just so with these powerful lights. You may produce the light of, say, 100 gaslights, and this light will penetrate to a very long distance, and brilliantly illuminate all objects falling within the path of its rays; the power expended in producing such a light may possibly be in exact proportion to the result obtained; but suppose it were necessary to produce a light of only 10 gaslights instead of the 100, the question then is—Will the expenditure of one-tenth of the power produce one-tenth of the light? Certainly not.

All experiments up to the present moment simply prove that the electric light, the lime light, and all lights of intensity, are only capable of being produced in such a way as to afford illumination greatly in excess of that required for ordinary domestic purposes. A knowledge of these facts ought to satisfy shareholders in gas works that it is not by the introduction of any such modes of lighting, as that of electricity or the lime light, that they need apprehend any depreciation of their property.

I may offer a word of advice to the directors and shareholders of gas companies, I would say, let them encourage a higher standard of technical ability in their engineers and workmen, and they will soon find they need not fear the introduction of any invention, however imposing its pretensions may be. Let a spirit of scientific inquiry be encouraged among practical gas men, and they will keep the process of gas-making well up to the requirements of the age; if they are men of education, they will accept and adopt improvements in the practice of their profession, let them come from whatever source they may. They will thus protect the property of their employers against all such sudden and uncalled-for depreciations as that recently experienced by the shares of metropolitan and some foreign gas companies.

Henry Gore.

Camden Town, July 19, 1877.

Statistics of the Coal Trade.

In a work issued under the title of "The Coal Trade," by Mr. Frederic E. Saward, Editor of the *Coal Trade Journal*, will be found a compendiu m

of valuable information relative to coal production, prices etc., both in this country and all over the world.

It contains many facts, arranged in most admirable manner, which are exceedingly valuable for reference. The book gives the fullest obtainable information as to the extent of the coal trade in its broadest sense; and while the statistics with reference to our own country may be more full and complete than those of other lands, still the main substantial facts as to foreign production, are given in a way that enables one to make easily the needed comparisons with our own. Some idea of the magnitude of the coal trade of the world can be formed, when it is stated that the total number of tons mined on the globe last year, amounts to something like 275,000,000 tons, of which Great Britain supplied 133 millions, the United States about 50 millions, and Germany 42 millions. To the gas maker there is much of interest as to the various caking and cannel coals of our own country. The various coals of each state are described fully. This is a book that will be extremely useful, and should be in every gas-maker's library.

Cantor Lectures.
The Chemistry of Gas Manufacture.

By A. Vernon Harcourt, Esq., M.A., F.R.S.
Lee's Reader in Chemistry at Christ Church, Oxford, and one of the Metropolitan Gas Referees.

[From the London Journal of the Society of Arts.

Lecture III.—Monday, March 19.

You saw that the beaker in which I burnt the gas just now became opaque. This arises from the imperfect combustion which has taken place. The sulphur of the carbon bisulphide was only partially burnt, and so a part of it remains deposited as flowers of sulphur on the sides of the beaker. That part of the sulphur which was burnt, united with the oxygen of the air to form sulphur dioxide, or sulphuous acid. When coal gas, hydorgen containing the vapour of carbon bisulphide, is burnt in the air, propbably in the first instance, the same substance—sulphurous acid—is formed. This oxide of sulphur is readily converted in the presence of the air and moisture into another substance containing an additional atom of oxygen—sulphur trioxide; or into that which is formed by the union of this body with water—sulphuric acid. I will illustrate to you, in the first place, one or two of the properties of the gas, formed by burning carbon bisulphide or sulphur itself. I have here some sulphur burning dimly with a pale blue flame. You observe that the transference from the air to a bottle of oxygen produces the same increased vividness in its combustion which you saw before in the case of charcoal. The sulphur now burns with a comparatively bright violet flame; and here also, although in oxygen, the combustion is imperfect. The white smoke which partly escapes from the bottle, and is partly deposited on its sides, is due to some of the sulphur which is now boiling, passing through the flame, escaping unconsumed, and then being condensed as a fine dust. I will try to collect some of the gas letting the sulphur burn for a little while longer in the bottle of oxygen, and I will then examine its properties.

Sulphurous acid is readily soluble in water, and when coal gas is burnt the two substances are formed and travel away together, the volume of steam being, of course, very large relatively to the volume of sulphurous acid. If we dissolve some of this gas water, we have at first simply a solution of it, but if that solution is allowed to stand for some while exposed to the air, and we examine it from time to time, we shall find there is in it an increasing quantity of the more oxidized and more permanent product of the union of sulphur and oxygen—namely, sulphuric acid. I have here an apparatus which is used for testing the amount of sulphur in coal gas, and which I have placed here intending to speak of it presently in referring to the modes in which the amount of sulphur in coal gas is ascertained. I will, however, refer to it now for another purpose.

If the little burner at the bottom of the tube is lighted, and the products of the combustion of the gas are allowed to pass up by themselves, without the addition of ammonia which is made when the apparatus is used as a sulphur test, and the condensed water, with what it holds in solution, is collected in the usual way, we shall find that the liquid contains sulphuric acid: but not nearly so much as when the pieces of ammonium carbonate, ordinarily employed, are placed upon the stand around the burner. In some experiments that I made, I found that about one-fourth of the total sulphur which the gas contains is obtained as sulphuric acid, when no ammonium carbonate is used. It has been contended, on the one hand, that, when gas containing carbon bisulphide burns in the air, the sulphur is wholly converted into sulphuric acid; and it has also been contended, on the other hand, that the only product is sulphurous acid, and that no sulphuric acid at all is formed. I feel confident, from the experiments I have made, that the truth, as so often happens, lies between the two. No sulphuric acid is formed by the combustion of coal gas; if sulphuric acid were in the game it would, on the contrary, be decomposed into sulphurous acid and oxygen. But when that which is formed in the combustion, steam and sulphurous acid, is condensed on a cold surface, sulphuric acid is produced by a secondary and gradual action of the oxygen of the air.

If the experiment is made of placing pieces of ammonium carbonate within the lower chamber of the condensing-tube, instead of round the burner, or some pieces of caustic soda on the top of the glass balls,—in either way keeping the condensing surface bathed in alkali, instead of allowing the condensed water to become acid, and the sulphurous acid which is formed to be exposed to the current of air which is passing through—we find that the whole of the sulphur in the gas is present in the liquid at the bottom of the apparatus in the form of sulphate. This does not prove that when the gas is burnt the sulphur in it is converted into sulphuric acid, but only that when the glass balls are steeped in an alkaline liquid the sulphurous acid is retained, and that, by the time the solution has trickled down into the beaker below, the salt formed is in the condition of sulphate, In the other case, where no alkali is used, but only condensed water, to arrest the products of combustion, sulphuric would be fixed as readily as before, since its aqueous solution surrenders none of it to a current of warm air, but sulphurous acid would be imperfectly retained. There is a very large volume of air passing up through the apparatus, and into this atmosphere the sulphurous acid readily diffuses out of the aqueos solution. I mentioned to you, in a former lecture, that a much more soluble substance than sulphuric acid—namely, ammonia—escapes entirely out of a solution freely exposed to the air. And that which happens to the solution of ammonia happens also to the solution of sulphurous acid. Allowed to stand, with a continuously renewed atmosphere over it, the gas diffuses out of its solution, consequently, a good deal of the gas which is formed escapes into the air, and it is necessary that there should be some alkali present in order to combine with the sulphurous acid, and to form a fixed substance, such as sulphite of sodium, for it to be permanently retained. When it is thus retained, and exposed for a little time to a current of air, it is oxidized, and the final product is an alkaline sulphate.

I will examine some of the properties of the sulphurous acid which I have formed in this bottle by the combustion of sulphur. I have here two colored liquids, and I will show you the effect which the gas has upon the liquids. I pour some sulphurous acid, which is more than twice as heavy as air, over the blue and over the red liquid in these two beakers, and stir with a glass rod. You see that in both cases the color disappears.

Now the substances which I have here used are delicate chemical reagents; the blue liquid was iodide of starch, and the red liquid was permanic acid—and acid solution of permanganic potash. I would not have you suppose that the effect which sulphurous acid has on these liquids at all represents the action of diluted gas upon ordinary coloring matters. It is true that by the gas, in so concentrated a form, many coloring matters are bleached; but when it is in a dilute form, its action upon coloring matters is, at any rate, exceedingly slight.

A question of much importance, both to the manufacturers and consumers of gas, is that of the injury which is supposed to occur through the presence of small quantities of sulphurous or sulphuric acid in the air of rooms lighted by gas. As to its effect upon health, I do not believe that there is any evidence that the small proportion of sulphurous acid which can be present in the atmosphere of a fairly well-ventilated room, through the combustion in the room of an ordinary quantity of coal gas, containing no more than an ordinary quantity of sulphur, is prejudical to health.

Fears have been entertained, with more reason, as to its effect upon objects in the room—articles of furniture or books. The strongest evidence of an injurious effect thus produced appears to be in the case of the decay of the binding of books. Several years ago there was a very careful investigation made into this matter at the Athenæum Club, by Faraday, Brande, and others. It was shown that the binding of the books was decaying; and it was observed also that the bindings of books placed in the upper shelves suffered more than those of books in the lower shelves; and it was believed that this injury resulted from the introduction of gas for the lighting of the rooms of the club. It was proved also that sulphuric acid could be found in the air of the room. Vessels of water, exposing a large surface, were placed in different parts of a room, and it was shown by degrees a considerable quantity of sulphuric acid was accumulated. But the evidence that the injurious effect was due to the sulphur from the coal gas is very imperfect. Evidence was given by bookbinders that there had been a change in the mode of preparation of the leather used in the binding of books—that more acid had been used after a certain date than before, and, in consequence, the bindings had not lasted so well. There were cases also of other libraries, in which no gas was used, where a similar decay in the bindings of the books had occurred, though to a less extent. Then as to the manner in which the injury was done. Supposing it were produced in some way other than by the gas, there was the further uncertainty whether it was due to the sulphur in the gas, or to the heat produced by the large quantity of gas burnt. As to the effect on

pictures, it is certain that some pigments—ultramarine, for example—are injuriously affected by the deposition upon them of acid liquid, and the canvas at the back of pictures is said to be destroyed by the same agency. But I believe it is found in picture galleries which are now lighted by gas, and where, as no doubt should be the case, great care is taken with the ventilation, that no injury has resulted.

There is, however, an objection which is very much more difficult to meet—namely, that persons living in rooms which are lighted with gas containing rather a large proportion of sulphur, find it disagreeable. Nor is this an objection which can be simply laughed at. It is not enough to say to a man who complains that he finds the atmosphere of his room unpleasant, that there is no evidence that that which he complains of is injurious to his health. It is not only that which can be shown to be prejudical to health which can fairly be the subject of complaint. Nor are experiments upon the quantity of sulphurous acid present in the air of a gas-lighted room, nor the conclusions which may be drawn from the rate of ventilation, and the amount of sulphur burnt, as to the quantity of sulphurous acid which can possibly be present, conclusive as against the complaint that the atmosphere of the room is found to be unpleasant, and that the unpleasant smell is that of sulphurous acid. The only logical conclusion to which a comparsion of these data can lead is, that a very small quantity of the gas is unpleasant. Mo own impression is that where ventilation is imperfect, as it commonly is, and the proportion of sulphur in the gas is rather large, it is possible to distinguish the presence of sulphurous acid. These direct sensations are not very describable to others; a certain sense rather perhaps of taste than smell, which is familiar to travellers by the Metropolitan Railway, and is known to chemists as that which sulphurous acid produces, may be observed in these circumstances, when no fire is alight, and sulphurous acid can proceed from no other source than the combustion of gas.

[To be Continued.]

Contributions to the Theory of Luminous Flames.

BY DR. KARL HELMANN.

[Translated from the "Journal of Gasbeleuchtung."]

[Continued from page 94.]

In a former paper, "On the Space between the Flame and the Burner," it was shown that this phenomenon is occasioned by the refrigerating influence of the neighboring body (wick or burner). The gas is cooled down below its temperature of inflammation, and the flame is accordingly extinguished in the immediate proximity of the cooling body.

With these observations may be ranged a similar phenomenon observed in the combustion of alcohol or coal gas, if either of these combustibles issue with great force from a tube. The experiment called the "luminous fountain" has long been known, and is produced by heating spirits of wine to boiling point in a hollow tube of metal with the end closed; on the opening of the cock, the boiling spirit is driven up with considerable force towards the ceiling. If a flame is brought near the point of exit, the spirit only burns near the ceiling, the column itself remaining dark; to inflame the latter, the exit-pipe must be surrounded by a rim containing some burning alcohol.

Not having this apparatus, I made a similar experiment, as follows: A copper flask was filled one-third full of alcohol, and closed by a stopper, from which proceeded a glass tube having an elbow joint, the horizontal arm of which terminated in an opening three millimeters wide. After the stopper had been properly fastened in by wire-thread, the spirit was made to boil violently. The vapor streaming out with great force could be lighted, and formed a large roaring flame, the base of which was ten to twelve cents meters from the end of the tube.

With this experiment I would couple a recent examination by M. Benevides, which showed that the flame of compressed coal gas does not begin at the point of exit, but only at a distance of several centimeters from it. The above-named author proved by experiment that the temperature of this dark space is very low—certainly a self-evident fact, for the gas cannot be hotter here than at any other portion of the conducting-tubes, because the process of combustion only begins where the flame becomes visible—that is, further down the stream. Benevides was induced to consider the existence of this intermediate space as a consequence of the mechanical action of the gas-jet, which forced back the air to a certain distance. This would cause the necessary oxygen to be wanting for a certain space, within which, therefore, combustion could not take place. If the exit-pipe was very narrow, and the velocity of the gas-jet very great, the violent displacement of the air would render combustion impossible, and the flame would be entirely extinguished.

I must confess I am not satisfied with this explanation; at least, it seems to me incomprehensible that the flame should not be able to exist because the oxygen is forced back, and that, therefore, want of oxygen caused the extinction of the flame. This takes place in the *interior* of every flame—not only in that of compressed coal gas—and is well known as the cause why flames are cold in their interior, and form, not solid, but hollow cones of incandescent gas. But this forcing back of the air is clearly only effective through a small space at the *outer* boundary surface, in which the chemical action—the process of combustion—takes place. Consequent upon the inter-diffusion of gas and air, the surface of contact becomes a layer of greater or less thickness, in which both gases are mixed in the necessary proportions, and so can form the flame-envelope.

All these are such well-known facts, that it would have been unnecessary to allude to them if Benevides had not set up his theory apparently without considering them. Increased pressure on the gas only enlarges the cold portion of the flame, and thus pushes the side wall and the head of the flame further away; but the flame-envelope cannot be extinguished at the sides, in consequence of the forcing back of the air, though this takes place in Benevide's experiment. There must, under all circumstances, be a boundary zone of combustible mixed gas and air. Why the combustion in this boundary zone is not propagated backwards is, therefore, the question to be answered, and for which the explanation of Benevides must be set aside as insufficient.

Two factors, of totally different natures, appear to me to be the causes of this considerable space existing between the burner and the flame of a strongly compressed gas—the absorption of heat caused by the rapidly succeeding stream of gas,† and the ratio between the rapidity of the gas stream and the rapidity of propogation of the inflammation. This latter point was alluded to by Benevides incidentally, but not included in his theory.

With respect to the refrigerating effect exercised by the rapidity of the gas stream on the lower portion of the flame, I should consider this as twofold. The layer of flame formed close above the burner is cooled by the gas stream in a similar manner as if a metal rod were inserted, though in a much smaller degree, on account of its inferior conductivity, and is extinguished for a certain distance—that is, the flame-layer in the lower part of the flame-envelope is thinned from within outwards. The force of the issuing gas stream also, as Benevides found, no doubt draws in the surrounding air. When the rapidity of exit is great, the air penetrates in excess into the lower portion of the flame-envelope, and abstracts heat from the outside. The action of the forcible in-draught of air and of the cold gas stream, therefore, mutually assist each other, and may, under certain conditions, be the cause of the flame becoming extinguished in the immediate neighborhood of the burner, and only appearing further down the stream, where the velocity of the constantly expanding gas-jet is sufficiently reduced, so that the refrigeration here is no longer so energetic.

That the gas cannot be lighted if the velocity of issue is very great, or that an existing flame is blown out by its own gas if the pressure is greatly increased, may be explained as follows: At first, in consequence of the increased abstraction of heat, a continually increasing space is created between the flame and the burner; in this long interval a considerable excess of air is drawn in, till, at length, when the velocity of the gas stream is sufficiently reduced, it is already so diluted with air that it can no longer be kindled.

The explanation thus attempted of the space between the burner and the flame of gas issuing with great velocity, assumes that this space is diminished, or disappears, when the gas stream is brought to a higher temperaure before it is lighted. Direct experiment confirms this assumption, for the flame of a strong jet of vapour of spirits of wine, issuing from a platinum tube, which was some centimètres distant from the point of exit, returned to it when the platinum tube was heated red hot; nor do I doubt that if the experiment of Benevides were repeated with strongly-heated coal gas—say, by passing the gas through some length of red-hot tubing before lighting it—a much smaller space, or even none at all, would be found to exist. But I do not possess apparatus suitable for such experiments.

Although these phenomena may be explained by the refrigerating action of the gas-jet, I am inclined to consider this action after all as very trifling; the fact that the space in the flame of the spirits of wine immediately disappears, if even a very minute flame is brought close to the orifice of the jet, goes to prove that the propagation of the inflammation is a far more important element, for the increased heat of the gas-jet by such a small flame can only be very trifling.

As another cause of the existence of this space between the burner and the flame in highly compressed gas, the ratio between the velocity of the issuing gas and the velocity with which the inflammation is propagated has been indicated. To obtain a clear conception of this factor, let it be suposed that the flame of the issuing gas-jet remains at a distance of several centimètres from the orifice of the pipe. The question arises, why is not the combustion propagated along the surface contact of the gas and the air backwards towards the burner?

The continuancy of a flame consists in the continual inflammation of the adjacent combustible particles by the heat developed from the previously inflamed particles. This propogation of the inflammation will, of course, take place in all directions, provided inflammable matter exists there, and as the space between the burner and the flame will also contain an inflammable mixture at the surface of contact between the gas and the air, the inflamation *must* be propagated backwards; and yet it appears as if it were not so. I say it *appears* as if it were not so, because we are apt to consider the flame as something independent and stationery, instead of what it really is—a small portion of a rapid gas stream, which is only visible to us for a short distance—namely, while it is incandescent.

Let us notice the construction of the magnesium lamps, in which the wire, by means of rackwork, is moved forward at the same rate as it is consumed. By this means the flame is constantly retained in the same spot, the focus of the concave mirror. If the movement is stopped, the flame will gradually burn backwards on the wire; if the wire is pushed forward too rapidly, the flame is moved further forward. The flame will only remain steadily in one place if the wire is pushed forward exactly as fast as the flame

* The refrigeration caused by the edge of the burner can only extend to its immediate neighborhood, not to such a considerable distance as that named above.

would burn backwards if the wire were immovable. This backward movement of the flame is necessitated by the propagaion of the inflammation; it will be effected more rapidly the higher the temperature of combustion, and the lower the temperature of inflammation is.

The rapidity of the propagation of inflammation is, therefore, in a direct ratio to the difference of two temperatures, and is in an inverse ratio to the difference between the temperature of inflammation and the original temperature of the body before it is kindled. The rate of propagation of the flame may therefore be increased by previous heating of the combustible; it is instantaneous as soon as the initial temperature is equal to the temperature of inflammation; it is diminished by reducing the temperature of combustion, as by the admixture of neutral gas; and the rate of propagation will be reduced to zero when the temperature of combustion is reduced to that of inflammation.

Besides the above elements, the rapidity with which flame is propagated will depend upon the specific heat and the conductivity of the combustible; it is probable that the area of surface and of a cross-section may also affect it, but these influences could be elimated in comparative experiments.

In case a refrigeration by the rapidity of the gas stream, and by the surounding air, is proved immaterial to the formation of the space in question, or if its effects can be elimated, comparative experiments might perhaps reveal some interesting relations between the rate of propagation of the flame of different combustibles and their temperatures of inflammation and combustion. For solid bodies, such as magnesium, the rate of propagation will exactly equal the speed with which the wire must be propelled forward, in order to keep the flame stationary at one point, or the time might be determined which elapses before the flame reaches the other end of a wire of known lengths, etc., etc. Inflammable liquid might be poured into a trough, and the time noted which elapses before the combustion, originated at one end of the trough, reaches the other end. For liquids that only burn with a wick, strips of linen of a given length may be saturated with the liquid, and the time also noted in which the flame reaches the opposite end of the strip when kept in a horizontal position, say, if stretched over wires. By means of such experiments, numbers expressing the relative danger from fire with combustible liquids might be determined.

For gases, the velocity of issue for a given distance of the flame from the burner, or the distance for a given velocity, might be determined. In order, however, to obviate the varying velocities, according to to the nature of the gas, at a given distance from the burner, it might be desirable to determine the precise velocity at which the flame is just raised from the burner.*

[To be continued.]

British Association of Gas Managers.

WEDNESDAY JUNE 13

Continued from page 94.

Mr. W. H. BENNET (London) read the following paper on

SOME OF THE CAUSES TENDING TO RESTRICT THE USE OF GAS COKE, AND HOW THEIR CONSUMPTION MAY BE INCREASED.

It might appear presumptious on my part to address you to-day upon a subject in which I assume much more of your time is directly engaged than mine, were it not that for nearly 25 years my mind has been directed to all that concerns gas lighting with an interest scarcely less than your own.

From my own connection with the profession, and from your intimate acquaintance with me, you will, I am sure, give me credit for a desire to advance your interests, which are the interests of gas companies, the interests of gas lighting. It is said that lookers-on often see much more of the game than the players. Certain it is that they often see both sides of the play, while the players are more or less confined to the side which they take, and their views are consequently narrowed in proportion. If, however, I advance opinions and make statements that may appear rather too radical to please the tastes of some, let me assure them that they are made for the purpose of conserving those interests it is our duty to promote.

To start with, we may ask ourselves, Why is it that gas is not more generally adopted for both lighting and heating in private houses? I shall reply broadly to this by saying that gas companies, as a body, have never sought to make themselves popular, and as monopolists it is difficult to do so; but unless the suppliers in such cases do make themselves popular, the use of the article supplied is sure to be more or less restricted. That gas companies are not popular is very evident. Let any one attend in the lobby of the House of Commons when any general gas question is about to be discussed, and seek the influence of the members on behalf of the companies, and he will hear remarks that will leave no doubt on his mind that, from some cause or other, gas companies have, whether deservedly or not, failed to become popular. The opinions you will hear expressed are gathered by the members from their constituencies—the public, the consumers. Now, why the companies have not made themselves popular with their consumers I do not know. Whether they do not sufficiently consider the requirements, convenience, and complaints of their customers I cannot say, but it is pretty clear the public think so; and the result, so far as the restriction of gas lighting goes, is the same, whether there is a good foundation for it or not. The very fact of having a monopoly is in general sufficient to excite, if not public antagonism, public suspicion, that sooner or later they will be, in some way or other, victimized, although that public should be the greatest benefiters thereby. I maintaian that a judiciously regulated monopoly is the best source from which such an article as gas can be supplied, that competition in gas, although fraught with some advantages to the consumers for a time, always ends in either districting or amalgamation when the consumer suffers as a consequence, and has to pay a price for his gas which will yield a profit upon an inordinate capital.

I never can divest myself of the notion that gas companies are nothing more than very large shopkeepers, save that they either, by force of circumstances or by parliamentary enactment, have a monopoly of the article in which they trade in their particular districts. Shopkeepers having no monopoly are, by competition, and by the hope of securing to themselves individually all the advantages of an increased trade, compelled to make themselves popular by studying and endeavoring to meet the wants, the conveniences, and even the whims of their customers. Does it not, therefore, become the more incumbent on the monopolists, by their liberal treatment—ay, and even by their forbaerance—to show that, while their own interests are studied, those of their consumers are kept steadily in view, it being evident that if the public are well and cheaply served, the greater will be the consuption of gas. As it is, I fear that too often rules and regulations are made by companies which appear arbitrary to the public, and induce it to think that such rules are merely made to increase the profits of the company, and without consideration for those from whom such profits are derived.

On the other hand, I am quite alive to the fact that the public is a hard master to serve, individually suspicious, and collectively, in the form of local authorities, often most unreasonable and exacting. But is it not therefore the most desirable that companies should pursue such an open and liberal policy as will dissipate the too easily engendered suspicion of the private consumer, and conciliate the local authorities? I am inclined to think that both parties too often determine to stand upon what they consider their rights, rather than concede, fearing that such concession might be taken as an indication of weakness instead of liberality. All this sort of thing tends, if not to diminish the consumption, to retard its increase, and I would reccommend all suppliers of gas to treat each consumer as if he were the person from whom the company must obtain their dividend. Do not, however, misunderstand me, and suppose that I would wish to see a servile and cringing, or anything-to-make-a-profit sort of policy adopted. That would be as distasteful to me as I am sure it would to you. What I mean is, I would at all times endeavor to be in advance of public opinion, and be ready to yield with grace rather than court contention upon trifles that singly amount to nothing, but in the aggrgate produce sufficient dissatisfaction to engender a troublesome, if not formidable, opposition.

I should be sorry to charge gas companies with apathy as to the extension of their trade, but I must say that, to a dispassionate looker-on, they never have seemed to exhibit that energy towards increasing the consumption that might be expected from an enterprising tradesman having unlimited capital at command, and under similar circumstances. Let me, however, save and except their conduct when they have had to contend with competion, for then, and then only, have they shown that vigor in endeavoring to increase their trade, which in ordinary commercial matters is necessary to ensure success. In the preceding, as in that which is to follow, I speak generally, and have no desire to make sweeping assertions without giving credit to those companies who may have been guided by a wiser policy.

Whether you agree with me in the foregoing remarks or not, I feel sure you will concur with me when I say, that when gas is supplied by companies they should be animated by a desire to increase the use of the commodity they supply, and whether supplied by companies or corporations it becomes the duty of the supplier to teach the public how best to use this commodity. In the case of corporations, it is their duty, because they allege as a reason for becoming suppliers that they seek to do so for the public weal; and on the part of companies it is a duty to their shareholders, because the education of the public in this respect will inspire confidence, and of a certainty lead to a true economy, and before long will, with as great a certainty, lead to an increased consumption, and if not an increased dividend, at least to the maintenance of a full one.

And here I may say I think suppliers of gas have, as a rule, signally failed to do what I think is a duty. It may be said, where are the managers, and how is it they do not take upon themselves this duty? My reply is—and I do not say it simply to please you—they have enough to do under the present system, in the majority of cases, in preparing, planning, constructing, repairing, and keeping in going order a large plant often extending over many square miles; in manufacturing, purifying, and storing, under circumstances of frequent difficulty, besides the systematizing and supervision of labor that often present still greater difficulties. I had hoped to be able to congratulate the managers this day upon the relief they would sooner or later obtain by the repeal, or reasonable amendment, of the sulphur clauses which appear in many Acts, and to meet which occasion a distracting attention on the part of the managers, to the prejudice of many more vital subjects, without any corresponding advantage to the consumer. But this relief seems now more remote than I had anticipated. I think, however, that, wherever circumstances have permitted, and a manager has gone beyond what are considered as his normal duties, and occasionally taken upon himself to lecture or otherwise instruct the public in the use of gas, great advantage has been the result, not only in satisfying the public that their interests are not neglected, and so allaying a spirit of discontent, or nipping in the bud an incipient opposition, but in leading to an extended use or an increased consumption.

Now, in my opinion, companies ought to encourage the managers in this respect, or avail themselves of other means of teaching the true economy of gas lighting and heating. In almost all towns of any mag

nitude there are mechanics or scientific institutions where an occasional lecture, accompanied by practical illustrations from the manager as to the facility, utility, and economy of lighting and heating by gas could be demonstrated with great benefit to both consumer and gas company. For the purpose of illustration, manufacturers would be only too glad to lend such apparatus as may not be kept at a gas works, for they lose no opportunity of advertising their wares, or exhibiting a spirit of commercial enterprise. It may be said that our friends Mr. Lewis Thompson and Mr. Rutter, our late friend Mr. James Shary, and fellow-members, Mr. A. H Wood, of Hastings, and Mr. William Richards, have written much with the view of instructing the public. All honor be to these men, I say, for they have done much good. But I think when such men as the late Mr. Sharp, Mr. Wood, Mr. McCrae, and Mr. West take upon themselves to lecture, they do infinitely more good for their own particular districts than any amount of pamphlet-writing could effect. People are more impressed with a good lecture, accompanied with illustrations and explanations as to why one system or one apparatus or one mode of lighting is superior to another for particular purposes, than they would be by giving them a score of pamphlets, which are too frequently cast aside unread. As an indication that this sort of treatment of the public is appreciated, I may quote a few words that fell from one of the audience who attended a late lecture by Mr. West upon the "Economic Consumption of Gas." He said that "he wished the gas company would assume a more active responsibility for the apparatus wherewith their product was consumed. The public should be accustomed to rely upon them for those suggestions and improvements in search of which they were now often made a prey by itinerant pretenders." As a further indication, you will always find these lectures well attended; and the remarks that fall, and the questions that are put after the conclusion of the lecture, show an amount of interest in the subject that is, at the least, very pleasing.

There is one point in the elucidation of which a lecturer has a great advantage over the writers of pamphlets, and that is the explanation of the meter. The meter is in the eyes of many of the public something worse than a conjuring-box, and is it not desirable that every means and every opportunity should be taken to dissipate the false impressions about this most useful instrument, which has played so important a part in promoting the consumption of gas? I say, is it not to the interest of gas companies to do all they can to enlighten the public in respect of this beautiful and equitable instrument, and thus remove the suspicions too frequently entertained towards it? And how can this be done better than by a lecturer who, with the apparatus in his hand, can illustrate what he is saying in a far more suitable manner than any books can afford? Teach the public, and when they have learned better, their prejudices will be removed, their confidence inspired, and their consumption will be the greater.

There is another thing I think should be encouraged by the gas companies more than it has yet been—that is, the use of gas for cooking. Much has been said and much written about the convenience and economy of cooking by gas, but, so far as I can learn, very little comparatively has been done towards promoting this object. Here and there, there is a company who has endeavored to push the trade, and who lets stoves on hire, but it is by no means general. Our friends Mr. Goddard and Mr. Magnus Ohren have each accomplished as much as any one in this reapect. The company that the latter gentleman represents I know lets stoves on hire. It is said, I believe, that such a letting involves some trouble, and that companies who did so years ago have ceased to supply them. This is questionable policy, for is it not our duty to cultivate a disposition to use gas for every available purpose? And we shall certainly fail in part to do that, unless we can offer to the public a means of making the trial with but small cost to themselves.

It has been reserved to the South Shields Gas Co., at the instigation of our friend Mr. Warner, to take a step with regard to the cultivation of the public taste for gas cooking and heating, that redounds greatly to their credit, and leaves them a worthy example to be followed. You are, no doubt, well aware that I allude to the exhibition of gas cooking and heating apparatus at South Shields, held in April last, where hundreds of articles, all varying in size, shape, and degrees of portability or adaptability to the uses for which they were designed, were to be seen. Many who are here can bear testimony to the great success that attended it; but there are few who were there the whole time, as I was, and can estimate the vast interest evinced by the public. It is stated that, in the five days that the exhibition was open, not less than 30,000 people were attracted; very many of whom expressed themselves highly pleased with what they saw, and complimented the company upon the course they had taken—namely, that of instructing the public in the advantages derivable from the use of gas. No amount of pamphlet writing or distribution would have the effect that I am sure will follow. Such an exhibition can only result in an increased consumption

There is another thing which tends much to the restriction of gas used in private houses, and that is, the miserably bad manner in which the fittings are often put up. The prospective consumer, not being invited by the gas company to seek advice at its office, goes to two or three gas-fitters, and probably enters into an arrangement with the one whose price is the lowest, and very likely the least capable of advising. In a short time, from exceedingly small pipes, placed at a wrong inclination, or sharp bends, there becomes a deficiency at the burners, or dancing lights ensue. Whose fault is this? The gas-fitter's? Oh, no, never! It's the bad gas! The fault of the company! at least, so the consumer tells his neighbor, and he has the authority of the gas-fitter, who is not inclined to admit that the fault lies with him. Now this, through ignorance on the part of the consumer, causes great discontent, and he does not hesitate to ventilate his dissatisfaction at every possible opportunity. But much, very much, of this might be obviated if the gas companies did the fitting, or had control up to the point of combustion. I am told that companies avoid the fitting business very often, and have shunned seeking control up to the point of combustion, for fear of making themselves liable for any accident caused by explosion or otherwise If a gas fitter puts up fittings badly, and an accident occurs, he is seldom made amenable for it; but if a gas company did the work, it is quite certain that an endeavor would be made to make them responsible for any injury arising. If, however, the gas companies had acted wisely, I think they would, ere this, have acquired, by general parliamentary legislation, power to supply and erect fittings, and to let fittings on hire with some control up to the point of combustion, and with some sort of limited liability. They have exerted their power reasonably enough at times; why not exert it in a direction so likely to result in the extension of their trade? The Wallasey Improvement Commissioners, in their Act of 1868, obtained power to make bye-laws for this sort of control, and the Leeds Corporation sought similar powers this year, but the Chairman of Committees of the House of Lords would not permit their remaining in the Bill, alleging that if such powers were requisite they should be obtained through a general Act; and although I was sorry to see that the Leeds people lost the acquisition of these powers, I concur in the reason that general legislation upon such a subject would be more desirable.

I am not one of those who are ready to exclaim on every occasion—"They manage all these things better in France," greatly as I admire some of their institutions; but I must say, and I say it with regret, on our account, that there are many things to be copied with advantage from our Parisian and other continental neighbors. The Paris Gas Company have done, and still do, much to induce the public to become consumers of gas. Connected with their general offices, there are show rooms, containing fittings and stoves of all descriptions, with attendants ready to explain and advise the consumer as to what is most appropriate for his requirements. Besides this, the company offer to place a "*conduite montante*," or service pipe, into every house, and allow the proprietor 100 francs (4£) if he will introduce fittings into three apartments, each fitting to consist of three burners, and they reckon as a burner a junction prepared to feed a heating apparatus; and for every additional fitting of three burners the company will allow a premium of 30 francs (25s.). You are, no doubt, aware that the houses in Paris are mostly let in flats, and are built upon somewhat the same principle that some of our Scotch friends know so well. Here again, if a lodger requires gas, and a service-pipe has already been laid in, the lodger will receive a premium of 30 francs for each fitting of three burners. These and some other premiums which the would-be consumer may obtain from the company, go far to pay the cost of his fittings; and thus, on the score of expense, leaves him but little excuse for not using the cheapest and most convenient light-giving agent. In this country, so far as I can learn, no approach has been made to such liberal terms as these. It may be said, in reply, that the Paris Gas Company charge a high price for their gas, and make such a profit as would cause the very hair of the cheap gas agitating fraternity of this country to stand on end. It is true that the Paris Gas Company charge a high price, and they are not limited to 10 per cent., but that is no reason why the liberal principles they display should not be followed, if not to the same extent.

And now with regard to coke. What is the reason that coke is not used more than it is in private houses? I am convinced that the chief reason is because the form in which it is supplied from gas works is too large for convenience, and requires to be broken before it is fit for use. It is a common complaint that servants will not use it if they can possibly avoid doing so, and I believe the cause is the labour and trouble of breaking it entails. But why do not the companies break the coke, and supply it in a more convenient form? It is said because the breaking involves expense, and produces much breeze, which in many places is unsaleable; but if such an instrument as I hold in my hand, and depicted on the diagram, were used, the coke might be broken with a minimum amount of labor, and the breeze greatly reduced. You will observe it is somewhat like a hammer, with a chisel edge at one end, and at the other has four prongs, like the four fangs of a double-tooth. This, when attached to a hazel or other elastic handle, forms so very excellent an implement that it has only to be tried to ensure adoption. The coke, when broken, may then be riddled through an apparatus, of which a diagram is exhibited. It consists of a frame or case divided by partitions, and within which a cylindrical sieve, having three or more divisions, is made to revolve, at an angle more or less inclined to the horizon. Each division of the sieve is of a different mesh, so that when the coke is introduced, and the cylindrical sieve made to revolve by turning a cranked handle, the finer parts of the coke will fall into the first compartment below, the next in size will pass on to that part of the sieve with the next larger mesh, and fall into a corresponding compartment, while the bigger pieces of coke will travel on still further, and fall through the largest mesh into its appropriate receptacle. Thus the coke may be separated into three or more sizes to suit the wants of different classes of customers. If such a plan were followed, I have no doubt a much more ready sale of coke would be afforded, and at a price that would prove more remunerative. As a proof of this, I have a return from a town in the vicinity of Paris where the coke is screened in the manner I have described, and divided into four sizes. The coke as produced from the retort is charged a certain price; but—

For No. 0, about	0·394 to 0·797	cubic inch in size, the Co charge 2s per chaldron extra.	
For No. 1	"	0·787 to 1·575	Ditto 4s. 1½d extra.
For No. 2	"	1·585 to 2·362	" 2s. 9½d "
For No. 3	"	2·362 to 3·160	" 1s. 4½d "

The gas company have also established a number of depots in different parts of the town, thus offering a great facility to the poorer as well as the wealthier classes for obtaining what they want in either large or small quantities, and of a size to suit their requirements. There is nothing new about this; both the system and the apparatus have been in use in Paris and other places on the Continent for many years, and English engineers are acquainted with the facts, but why they have not introduced the system here is a mystery to me. Where the breeze is an unsaleable article, it might be converted into artifficial fuel, by passing it, together with a small quantity of tar, through such a machine as Mr. George Anderson brought to our notice years ago, and thus find a market. Such a system would yield an increased revenue to the gas company, and show a disposition to give the consumer all the advantages the presence of a gas work could afford. I am sorry to say, however, that the very opposite policy occasionally prevails, for very recently a case was brought under my notice in which the gas company, having a large stock of coke on hand, entered into an arrangement with a contractor to supply him at 6s. per chaldron, upon condition that it was disposed of out of the town, in order to keep up the price in the town and amongst its own consumers to 11s. I am told that this is not a solitary case; but I should hope, for the honor of gas companies, that it is, for such a policy cannot be too highly deprecated.

There has been very little written about the advantages of coke for house consumption. Our ever-active friend, Mr. Warner, produced a little pamphlet some years ago, containing extracts from different authors, and interspersed with some original matter upon this subject; but that is about the only thing I have seen done towards convincing the public that coke is really an excellent house fuel, and superior to coal for some purposes.

Here again the Paris Gas Company have shown more enterprise for they undertake to supply any number of stoves especially adapted to the burning of coke and artificial fuel at cost price, and so allow the consumer to test the applicability and economy of these fuels at the least possible expense to himself. Surely this is a matter worth considering by our own companies.

I now come to a part of my subject that more immediately concerns you as managers, and I feel some delicacy in touching upon it lest I should be misinterpreted. I believe that gas managers, as a body, are as honorable a set of men as one can find, zealous in the performance of their duties, and jealous of their integrity. I believe that each one of you thinks he is doing his utmost to promote the interests of, and secure the best dividend he can for, his company; but if a system of remunerating managers in proportion to results were introduced, I think in a very short time every manager would find that he could surpass his former self. I believe that we often sincerely think that we are doing our very best, when, if our direct interests were awakened by the certainty of reward for our increased exertions, we should make efforts, of which we know not our own capability. That such a system of remuneration may present difficulties I am aware, but I am satisfied they are not insurmountable. It is impossible to lay down a scale that would meet all cases, but I think it is quite possible to frame a general rule that might serve as a basis for modifications to be adapted to particular instances, and I am quite sure that if such a system were adopted, you would profit greatly by the change not only pecuniarily but morally, for you would feel more independent; you would then demand as your right an increased reward which you now have often to wait for until long after it is earned, and then receive it as a favor. Such a system would, I believe, do more towards cheapening the price of gas and maintaining full dividends than any scheme ever tried, and in proportion to the cheapness of gas, so also would be its increased consumption.

Upon the same principle, I could say let the manager participate in the profits arising from increased consumption. Give him, I will not say, *carte blanche*, but more liberty to act untrammelled, and more in the capacity of a gas manager than as a mere gas maker, and we shall very soon find that the increased consumption will be greatly in excess of the present average 10 per cent.

As a proof that this reasoning is well founded, do we not find that a lessee can afford to pay a company a fair dividend, and still make a respectable profit for himself? Why is this? It is because he knows that his profit depends upon, and will be in all probability in proportion to, his own exertions.

If the foregoing remarks have the effect of directing your thoughts into channels that have not yet been sufficiently investigated, or in any way contribute to the objects for which we are assembled, I shall be much pleased, and consider myself well repaid. If, however, you think that these observations have been made in too censorious a tone, and that I have taken the side of the consumer rather than that of the supplier, rest assured that I have done so under the firm conviction that the true interest of every supplier is to study the interest of the consumer, and that while I am most anxious to see a greatly increased consumption of gas, I am equally anxious to witness the increased prosperity of every one connected with the science of gas lighting.

Mr. Warner (South Shields) regretted that this paper had been put down last on the list, as there was much suggestive matter in it, and unfortunately no time was left for its discussion. He had long since held that it was not only the duty of managers individually, but also collectively, to furnish instruction to gas consumers. His opinion was that, as an association, they should not meet in any town without having some instructive public lecture given. He was quite sure it would be attended with beneficial results.

Mr. Sellers (York) said the company with which he was connected were very popular, because they studied the interests of the public. They did a large share of the gas-fitting business in the city, and that enabled them to see that the fittings were put up properly. With the regard to the suggestions in the paper just read, he thought all the members would be agreed. Touching upon the use of coke, he remarked that in York for two or three winters, consequent upon the depression of trade and the unusual mildness of the season, they had had some difficulty in getting rid of their stock. They had, however, very successfully combated the difficulty by the issue of a circular calling the attention of the public to the economy of coke as fuel, and by having their own horses and so as to be able to deliver the coke at the consumers houses.

Mr. G. Anderson (London) said he was happy to find himself in thorough accord with the writer of the paper. The first business of a gas manager was to provide an ample supply of gas as pure as possible, and then he had nothing to fear. It was, of course, his duty to be polite, but he was not called upon to be sycophantic. Let him do his duty, and no one was more entitled to respect than the gas manager; and, for his own part, he had always found that, in the end, he gained the confidence and esteem of his consumers. He would only remark, in reference to the paper, that he looked upon the suggestion to break up the coke as an admirable one. For a number of years he had been in the habit of having it broken up with hammers, but he had since devised a machine for more satisfactorily accomplishing that purpose. No doubt a great deal of the prejudice against the use of coke arose from ignorance. Unfortunately, domestic servants were not philosophers, though Board schools in time might make them so. As to giving managers an interest in the work done, and for extra skill employed, he quite agreed in the remark. Under such conditions they might without knowing it, introduce improvements never thought of before.

The President said he thought no one present had more ground for grumbling than himself. It appeared now that the most valuable people in the world were lecturers, and poor wretches like himself, who wrote pamphlets, were no good at all. He had only lately taken to pamphleteering, and after what had just been said he thought he had better at once leave it off, although hitherto it had only been done under the pressure of circumstances, and for the sake of amusement. But, after all, he must admit it was quite true lecturing or talking was the thing. One could not always be writing, but one could be always talking, and no doubt good impressions were produced among consumers if one could only get their ears Let them clearly see that the gas manager understood his business, and that he had nothing to conceal, and let them understand that the interest of the gas company was *their* interest.

The Mechanical Theory of Heat.*

From "The Engineer."

The subject of this work is one which has become increasingly popular in proportion as it has been studied by the application of the sciences of Mechanics and numbers. Like several other branches of science, it has become more interesting, and of wider importance, as the cobwebs of unsupported speculation have been removed under the light of experimentally ascertained facts. It is true that much of what we know of the nature of heat, as far as its analogy to light is concerned, was dimly foreseen by some ancient writers: but, as the author of this work observes, imaginations are of no value, and of little merit, so long as they remain barren of positive results. The first chapter of this work is a brief historical sketch, which places before the reader the names and the nature of the work and claims of those to whom we are chiefly indebted for the development of our knowledge on this subject as we now understand it. Commencing with a reference to the celebrated "Traité de la Lumière," in which Huygens, in 1690, published his demonstrations of reflection and refraction, regarded as phenomona of wave propagation, and commenting on the Newtonian hypothesis that light and heat are matter, one which obstructed the progress of knowledge for more than a century, the author passes on to the work of Young and Fresnel, laying much stress on the claims of the latter. The remainder of the chapter, and the largest part of it, is chiefly occupied by the result of the work of those who originated and developed the mechanical theory of heat—Rumford, Seguin, Meyer, Colding, and Joule of course, occupying most attention. A spirit of fairness characterizes this chapter, in which, while giving full credit to Rumford, Mayer, and others, Joule, is accredited with the merit of having caused the true theory of heat to meet with general reception. Perhaps a little too much is claimed for Huygens and Fresnel, for while admitting the splendid achievements of both, it must be remembered that until Rumford's experiments upon the mechanical equivalence of heat, his practical and indisputable proof by measurement, their work and discoveries remained so far in the condition of hypotheses, that they could be and were received by some and rejected by other equally eminent men. The proof of actual measurement by mechanical means was necessary to remove the possibility of the existence of difference of opinion in equally competent minds, and for this proof we are most indebted to Rumford and Joule. The experiments of Hirn are not forgotten in this chapter, full reference being given to his determination of the quantity of work done by heat, the inverse of the problem solved by Joule, and which he determined by a series of experiments with 100 horse power engines. By these experiments it was proved that the efficiency of the Woolf engine was as much as from one-eighth to one-seventh, or about double that obtainable according to the calculations of Regnault, which led him to believe the steam engine a more wasteful machine than it really is. The apparent differ-

* "Treatise on the Mechanical Theory of Heat and its applications to the Steam Engine, &c." By R. S. McCulloch, C. E. Professor of Mechanics in Washington and Lee University, Lexington, Va. New York: D. Van Nostrand: London: Trubner & Co. 8 vo.

ence between Regnault's conclusions and actual measment was removed by Rankine, who explained it in 1849 by showing that a certain quantity of work was done by the steam which had given up heat by condensation in the cylinder. For the purpose of demonstrating this Hirn had glass plates let into a pipe attached to engines working with a pressure of 75 lbs. per square inch, by which he was ecabled to see the steam, which was transparent at 307 deg., become clouded with liquid vesicles during expansion.

It should be here said that Mr. McCulloch's book is an advanced scientific treatise designed principally for the use of students, and without any pretense to being a popular treatise. To be able to appreciate the mass of information, the unbroken chain in which the many different parts of the subject form appropriately arranged links, and the deduction from these, the reader must possess at least an elementary knowledge of the calcus and of analytical geometry. To enable to make intelligent progress in the study of the mechanical theory and equivalence of heat, it is, of course, necessary that he should well understand the fundamental laws of mechanics, and for this purpose the second and third chapters of the work before us deal with dynamics, in order that a proper conception may be formed of the ideas conveyed by the terms, "work—energy—potential and kinetic—force conversation and dissipation of energy—transformation of energy, &c. &c., particularly in their thermal applications." Little need be said of these two chapters. As brief expositions of abstract dynamics they are lucid and careful, but in some instances they are too brief to be of any service to the student, and this is particularly noticeable with reference to the "work of heat" and "work of expansion," which are without sufficient explanation, and are dealt with in about one and a-half page. Chapter IV. is devoted to a discussion of the general laws of heat and thermodynamics, and Chapter V. deals with "airs and vapors," and presents able examintions of the experiments and laws of Gay Lussac, Marriotte, and Rankine, of the influence of temperature upon compressibility, expansion of vapors. In the three succeeding chapters, the most recent interpretations of the known phenomona of heat are examined and applied under the heads of "Internal Energy," "Thermal Laws" respectively. Part II. of the work deals with "applications," the first and second chapters of this part. Nos. IX. and X· form a carefully-considered digest of most of the laws relating to steam and vapors as bearing upon thermondynamic questions, "Steam engines, their defects and improvements" are the subjects of XIth chapter, and Chapter XII. consists of miscellaneous applications. Want of space prevents our reference at any length to the former of these two chapters, or at all to the last. There are some expressions, however, which show that the author has sufficiently cnnsidered his eleventh chapter to make it of service to either engineer or student. For instance, under the head of "Defective Fxpansion," the author says that "incomplete expansion is one of the principal defects of the steam engines," and "the table of Clausius shows that between the temperatures of 150 deg. and 50 deg. C. the expansion of saturated steam is 25.7 or nearly 26 times its original volume. For such dilation cylinders of enormous size are requisite."

The latter sentence is practically the only one which suggests that there would be any difficulty in what the author terms complete expansion, and it is dissapointing in such a work to find no mention of the principal difficulty to such ranges of expansion—namely, that very reduction of temperature which he has mentioned, or the refrigeration due to expansion, a question which could not be left out of sight with propriety, unless some perfectly nonconducting material had been found in which to conduct such expansion without positive loss. Again when considering the use of superheated steam, the author, in common with many other writers on the subject, observes, "the *chute de chaleur* or difference ( ) upon which the duty of an engine depends cannot, therefore, be much increased by making the boiler hotter," *i. e.*, because a pressure of ten atmospheres with a corresponding temperature of 180 deg. C. "cannot be much exceeded without danger of explosion." It would, no doubt, occur to most engineers that if the duty of an engine depended alone on a range of temperature in the cylinder, that the difficulty of making sufficiently strong boilers would soon be overcome. With a perfect ideal engine the *chute de chaleur* would undoubtedly be a measure of its efficiency, but in considering the applications of thermodynamics to practical engines, the reader might have expected teat some inquiry would have made into the economical limit to this range of temperature and the conditions which determine that limit. It may be said that this question is somewhat apart from the object of this work; but as practical applications are considered, it seems to us that this important practical question should have been discussed.

In this work Watt is of necessity very frequently referred to, and full justice is done to the magnificent results of his invention and work, but wey the author should have designated him Sir James Watt is unexplained. This title was offered to Watt a few years before his death, but, although pleased with the kindness, he declined to accept it, a decision which if he had lived now, he would perhaps arrived at without even consulting his sons on the matter, as he then did. It is also somewhat curiaus in a work of this kind, in which only ascertained fact is dealt with, to find the author, both in his preface and in his conclusion, writing about the docile acceptance of a faith, and commenting on "human perversity which seems to incline some to prefer the Arctic scepticism of negation to the genial warmth of Coristion faith," in a manner which, in such a work, seems at least out of please.—*Van Nortrand's.*

On the Purification of Coal Gas.

BY DR. H. BUNTE.

[Translated from the "Journal fur Gasbeleuchtung."

[Concluded from page 24, No. 2.[

In the foregoing remarks special emphasis had been laid on the ammonia liquor as produced in gas manufacture, not being applicable with advantage to the complete purification ot the gas on account of its weakness—that is, its small content of ammonia.

It is, therefore, necessary to form a concentrated liquor, caustic ammonia, from the raw liquor, for the purifying process. The production of this fluid does not require any special apparatus, but is carried on everywhere, or may be carried on, where the gas liquor is properly treated for ammonia salts by the process of Mallet or Solvay.

In gas works where the production of ammonia salts is carried on, the introduction of the purifying process offers no difficulties. The strong ammonia water is gained by distilling off a larger quantity of the gas liquor, and condensing the vapor in other gas liquor till it has attained the required strength. The cost of the fuel, etc., will be saved later on in working up the spent liquor for ammonia salts.

Continued wetting of the scrubbers with the same ammonia water will also produce the required concentration. The liquor from the hydraulic and the condenser must, of course, be kept separate from the portion intended for purifying.

When the ammonia water is brought to the required strength, it is freed from the greater portion of the sulphuretted hydrogen and carbonic acid by the somewhat modified process known as Hills's process, and then again pumped over the scrubbers. When it has recovered from the gas the volumes of SH_2 and CO_2 removed in the regenerator, it is again submitted to this latter process.

The portion of ammonia water employed can, therefore, in theory, purify an unlimited quantity of gas from sulphuretted hydrogen and carbonic acid. The process by which this is effected may justly be called regeneration.

The action of the ammonic salts, discussed earlier on, especially that of the only two at present in question $(NH_4)_2\ CO_3$ and $(NH_4)_2\ S$, offer a ready means of removing the greater part of the carbonic acid from a solution containing these two salts, and generating free caustic ammonia.

If a solution of ammonic carbonate is heated above 60° C., the salt contained in the solution is decomposed. The constituent elements, however, remain, for the most part, dissolved in the water, as the limit of saturation for ammonia, at the concentration assumed, is not reached (according to Sims's tables), and the capability of absorbing carbonic acid is increased by the presence of the ammonia.

By increasing the heat, the tension of the gases CO_2 and NH_3, retained in the liquid by physical attraction, is increased, and at last becomes so great that the gases escape in bubbles, the carbonic acid first, and afterwards the ammonia, the latter being more strongly held by the water.

This action may be easily demonstrated by the following experiment: Into a nearly saturated solution of ammonic carbonate a piece of the solid salt is introduced; a violent evolution of gas immediately commences, the escaping gas being chiefly carbonic acid; the remaining solution, must, therefore, contain less carbonic acid in proportion to the ammonia than the solid salt.

This proceeding also shows clearly the decomposing power of water, for the solid salt evolves no carbonic acid (or only a very small quantity with ammonia) at the same temperature at which, in water, it yields streams of CO_2. It also demonstrates the prejudicial influence of too much weakening on the formation of acid salt, and explains why acid salt is only formed in those parts of the works and the pipes where there is but little water.

The formation of free ammonia in a solution of ammonia carbonate is even more clearly exhibited, if the solution is heated to boiling for a few minutes. The liquid, after this operation, contains besides undecomposed carbonate, free ammonia. To prove this, it must be supersaturated with an excess of chloride of barium. The ammonic carbonate forms with it ammonic chloride and carbonate of baryta. The strong reaction of the liquid over the ($BaCO_3$) precipitate can only be caused by free ammonia, as the other salts dissolved in the liquid, NH_4Cl, $BaCl_2$, do not react on each other.

Quite analogous to the above simple experiment is the regeneration of the ammonia water, which consists principally of a solution of ammonic carbonate, or may easily be converted into it.

The salts of the gas liquor concerned in the purification and regeneration are ammonic carbonate and hydrosulphuret of ammonia.

To remove the sulphuretted hydrogen contained in the gas liquor, the concentrated ammonia water intended to be regenerated is passed over oxide of iron. To effect this, arrangements similar to those for lixiviation as followed in soda works are suitable. The sulphur withdrawn (about 8 kilogrammes per cubic meter of the gas liquor B) can be easily recovered.

(1.) By this operation the sulphur contained in the gas liquor, which has hitherto been wasted, may be utilized.

(2.) The ammonia, hitherto combined with the SH_2, is recovered free and available for further use in purifying.

The gas liquor, consisting now chiefly of ammonic carbonate, is heated. The apparatus constructed by Hills and Solvay would, with some slight modifications, which practice would soon indicate, be quite suitable; the principles on which they are constructed have proved them selves rational.

When the sulphuretted hydrogen is removed, the process becomes much simpler, and the regeneration more complete.

If any carbonic acid and sulphuretted hydrogen were absorbed from the gas, the purifying liquid could be used for a long time, especially as any loss of ammonia during regeneration, if the ammonia liquor be of the proper strength, is replaced automatically from the ammonia-containing gas that enters the scrubber. But besides the reactions considered,

others take place, by which a portion of the ammonia is lost for purification.

One of these reactions is occasioned by the presence of sulphide of carbon in the gas, with ammonia or sulphide of ammonium. This body converts a portion of the ammonia into sulphocyanide of ammonium giving off sulphuretted hydrogen*:

$$CS_2 + (NH_4)_2\,S = CS\begin{matrix}SNH_4\\SNH_4\end{matrix}$$

$$CS\begin{matrix}SNH_4\\SNH_4\end{matrix} = (CSN)\,NH_4 + 2SH_2$$

The sulphocyanide of ammonia thus formed is lost for any further purification of the gas, as it cannot be regenerated. Still, these and similar decompositions can only be regarded as minor reactions, which do not affect the utility of the method in any way.

The cost of this process can only be approximately estimated without practical experiments. The dimensions of the apparatus and gasholders employed, and the expenditure of motive power per 1000 cubic meters of gas, may be calculated by a practical man, according to the circumstances of each case, from the figures given above. As in the above process, the regeneration of the ammonia liquor takes the place of the cost of fresh purifying material, a comparison of the cost of these two items will lead to a tolerably accurate conclusion.

According to the communications of Hanrez (*Journal for Gasbeleuchtung*, 1877, p. 4) on the use of Solvay's boiler for preparing the gas liquor, the expenditure of fuel for one cubic meter is 36 kilogrammes of coal. As the regeneration does not require the complete removal of the ammonia and distilling over a portion of the liquid, but only the heating of the liquor to be regenerated to about 90°, the above estimate may be considered ample.

As, for 1000 cubic meters of gas, one cubic meter of ammonia liquor of the strength A must be regenerated, an expenditure of 36 kilogrammes of coal should procure purifying material for 1000 cubic meters of gas. But as I have no other working results before me I cannot speak as to the correctness of these figures.

The whole method, as above described, and in part explained, is intended to introduce one single wet purification instead of the present separate wet purification in the scrubber, and dry one in the oxide of iron purifiers. The importance of this step—the doing away with a great part of the dry purification—becomes obvious when it is remembered that the dry purifiers are the most critical of the whole apparatus, and by means of the wet purification a continuity is attained quite impossible with iron oxide.

If the advisability of converting dry into wet purification is admitted, the immediate practical result will be an extension of the scrubber system, and the supersession of the dry process by washing with the strongest possible ammonia water.

As to the other apparatus used, the principal requirement is to separate the tar as completely as possible from the gas before passing the latter through the scrubber, for without this a uniform wetting and thorough utilization of the ammonia water cannot be effected. Apparatus lately devised for distributing the ammonia water and thoroughly wetting the scrubbers will assist in carrying out practically the wet process.

The general conclusions enunciated above with respect to the purification of coal gas generally, and the removal of carbonic acid in particular, are based on special researches carried out at the gas works at Munich, and on the experience of others as made known in print.

I am quite conscious that these researches are by no means complete, and in many points require to be confirmed by further experiments, which I hope before long to be able to undertake. Meanwhile the results ascertained may be summed up in the following conclusions:

(1,) The gas liquor obtained in the distillation of coal is too weak to be applied with advantage to purification.

(2.) To purify the gas, the ammonia liquor should be as strong as possible, which may be attained by methods already known.

(1.) Hill's process is based on rational grounds, and if the solution to be regenerated is sufficiently concentrated, will render the application of the wet process of purification possible.

(4.) The regeneration of strong ammonia liquor can only be profitably effected after decomposition of the sulphuretted hydrogen and elimination of the sulphur by oxide of iron.

(5.) The gas liquor collected in the hydraulic and the condenser in making the gas must be kept quite separate from that destined for purification.—*Journal f Gas-Lighting.*

* To this reaction the greater quantity of SH2 contained behind the scrubber than before it may partly be ascribed.

Stone-Dressing Machinery.

An important practical advance in machinery for dressing and surfacing rough stone has been lately made by Messrs. Brunton, Brothers, of Battersea. The want of a good and effective stone-dressing machine has always been felt by those engaged in preparing stone for the market. That want has now been supplied by Messrs. Brunton's machine, which is in operation at Messrs. Allan Ransome & Co's foundry at Battersea, Messrs. Ransome being the manufacturers of the machines. It is true that attempts have been made from time to time to produce stone-dressing machines, but they have for the most part proved complete failures. Owing to the intractable character of the material to be dealt with, the tools employed have always succumbed to the obdurate stone. It is the structure of the tool and its mode of acting which constitutes the peculiarity in the machine indicated. In this lies the secret of the success with which it dresses the hardest granites and the most wearing grits.

The machine consists of a bed-plate with standards carrying the dressing apparatus. The stone to be dressed is fixed to a travelling table, which is mechanically moved backwards and forwards under a set of revolving cutters. These latter consist of three circular discs of steel, projecting from the under side of a chuck in which they are carried. Each cutter has a rotary motion of its own, and the chuck also revolves with them.

The cutters revolve very rapidly over the face of the stone and clear off the rough surface with astonishing rapidity, the wear and tear of the cutters being remarkably small. The machinery can dress blocks of Aberdeen granite at the rate of one and a half feet superficial per minute, while an exceedingly hard grit stone was dressed at the rate of two feet per minute. Ordinary limestones are put through at a very rapid rate, being cleaned off like so many blocks of chalk. The chuck or cutter holder revolves at the rate of 500 revolutions per minute, while the cutters make 1,200 revolutions per minute each, a rate of speed which easily overcomes the hardest resistance the stone can offer.

Although the machine is only intended for dressing flag-stones for paving, it readily dresses granite, as we have stated, and even French Burr stones have been dressed by it. As an example of what Messrs. Brunton's machine will effect, a small obelisk of Aberdeen granite was lately shown, three sides of which had been dressed by it. The fourth side was left undressed to show the rough surface the machine had to work upon at starting. The block was four feet three inches high, and ten inches square at the base, tapering to seven inches at the top. The first side was dressed over twice in nine minutes fifty seconds, and the third five times in twenty-six minutes thirty seconds. The reason the third side had two extra dressings was because it presented a very irregular face. It will be seen that the total time for dressing the three sides was about 48½ minutes. It is stated that one side would constitute a fair day's work for a man, so that it will be seen that the gain in time is enormous, while the quantity of the work done is excellent, the edges and corners of the stone being left sharp and true. Several of these machines, specially suited for granite, are being made by Messrs. Ransome for use in Aberdeen.—*Iron.*

Gas.

It is one of the duties of every newspaper to discuss and often to criticise the municipal arrangements for the comfort and convenience of the people, and in the fulfillment of this duty articles have several times been published in the *Eagle* respecting the management of the street lights, in which what was done has been sometimes found fault with, and improvements have sometimes been suggested. We hear now and then that these criticisms are understood as applying to the Citizens Gas Company, which furnishes the light, and are taken as an indication that there is something wrong in the quality of the gas furnished, and of the light itself. In part this understanding is correct. The Company did make some imperfect connections, causing trouble which might have been avoided, and some of its employees have at times been careless in doing their duty, but when attention has been called to these faults they have, we believe, been promptly remedied. As to the gas itself we have never had any cause for complaint, and if a contrary impression has been produced by any one of our former articles we desire to correct it by a brief statement of what we know. The Citizens Gas Company has now been in operation in this city something over two years. When it was started there were predictions of all sorts that it would be a failure. It makes gas by a new process, known as the hydrocarbon process, separating water into its chemical elements, hydrogen and oxygen, and then carburetting the hydrogen so as to make illuminating gas. It was said by those who claimed to be experts that this method was impracticable, that the gas formed by it would be poor in quality, that it would not be permanent or uniform, that it would not be good for anything in cold weather, etc., etc. Every one of these predictions has proved erroneous. Of the relative economy of production as compared with the old process we know nothing except what we have been told, but as to the quality of gas, we are competent to pronounce judgment, as we are large consumers and have used both, the new since its introduction here and the old for years previously. And we state unhesitatingly that the gas produced by hydro-barbon process, as used by the Citizens Gas Co., is not merely equal to but decidedly superior to the gas produced by the old process. Its points of superiority moreover are just those in which it was predicted that it would be inferior. It is more uniform in brilliancy, and shows no signs of deterioration in extreme cold weather, as the old gas always did. Moreover, it appears to be richer in illuminating material, and a small quantity is required to produce the same light, the meter showing a smaller consumption, and consequently a reduction in cost. We have no interest whatever in the company here, nor in the process, but we make these statements as a matter of justice to all concerned.—*Poughkeepsie Daily Eagle, Aug. 29.*

Gold in Ontario.—A *bona fide* discovery of gold has been made at Gravenhurst, in the Muskoka district, Ontario, but whether it can be profitably worked or not is yet an uncertainty. One of the old settlers, in sinking a well observed a glittering substance in a quartz pebble which was thrown out, which on examination proved to be gold, and after a search was instituted a number of nuggets of small size were found. They lay in a bed of sand and gravel some thirty feet below the surface, and further search is now being made to ascertain if this vein is widespread or only local. The proprietor of the land refused several good offers for purchasing his property till something more definite is known.—*Ironmonger.*

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MONDAY, SEPTEMBER 17, 1877.

Utilization of Sewage.

On Friday, the 29th ult., Mr. Alfred Fryer, Nottingham, addressed the members of the Derby Town Council, acting as the Sanitary Authority, and gave an "account of certain processes for utilizing night soil and other town refuse, under which these accumulations are said to be practically reduced in bulk by burning, but the residuum is rendered most valuable as a manure." He commenced by remarking that he was not present to speak upon a vague scheme, but to explain a system of utilizing sewage which was matured and adopted to a large extent at Manchester and Birmingham, where apparatus at great cost was being erected, and he had that week signed a contract with the Corporation of Leeds. He referred to the importance of disposing of the refuse of towns in an economical manner, and at the same time without imperilling the health of the inhabitants or causing any infringement upon their sense of decency. It might be convenient, in considering the question so far as it affected most inland towns, to subdivide the refuse into three classes—refuse that could not be removed by water transit; refuse that must be removed by water transit; and refuse that may be removed by water transit. He proceeded by saying:—The groups of substances which cannot be removed by water transit are obviously solids, and these may be classed into mineral and vegetable matter. The former consists mainly of cinders and ashes from house fires, and, together with these, broken earthenware and glass, oyster shells, and some portion of metal. Where the old-fashioned ash-pits or middens exist, these substances are frequently soaked with water, and are offensive by the the admixture of faecal matter. Though these substances contain a portion of combustible matter, they are blended with so much incombustible material, they are so choked with dust, and saturated with water, that instead of being capable of ready ignition they would quench any ordinary fire upon which they might be placed. This material is very difficult of disposal. It possesses no value as manure, when piled in heaps it often becomes offensive, and as the dust bin is usually the receptacle of solid refuse, it contains the dust and rubbish swept from the rooms of scarlet fever and small pox patients, and not unfrequently portions of clothing which spread the germs of disease in the air, and serve to convey it still more certainly to the homes of poor creatures, who often search the refuse to glean such perilous treasures. No wonder that zymotic disease starts out without apparent cause in the lower parts of the towns, where it can be conveyed to them as effectually as the plague was carried from London in some woollen clothing to your own mountain Derbyshire martyr village of Eyam, 211 years ago. The Health Committee of Manchester have for some time demonstrated that ashes and clinkers, when ground with hydrate of lime, make a most excellent and tenacious mortar. They were, however, unable to deal with the refuse I have adverted to. They could not burn it *en masse*, and if any of the material tainted with fœcal matter were used, the matter became offensive.

To deal with this difficulty the patent destructor was devised. The object aimed at was a furnace so arranged that when once ignited, the radiant heat generated should not be permitted to escape, but should be reflected upon the material so as to intensify the combustion and raise the temperature as much as possible. This having been effected, the heated products of combustion should be passed over a further supply of material, which could thus be deprived of its water, and raised in temperature ready for active combustion when its turn came to reach the furnace proper. Such, then, is the destructor. The material treated is frequently indistinguishable from wet mud. Cartloads of bricks saturated with water or urine, bottles, glass, etc., are shot into these furnaces, and they are made red hot. All water is evaporated, all organic matter is decomposed, all combustible matter is consumed, and the mineral matter is alone left "purified as by fire." No smell is produced by the burning. Two-thirds of the mass disappear, and the residue of ash and clinker, fused glass and earthenware offering sharp angular fractures, furnishes, when ground with lime, a mortar for which there is abundant demand. There is no fear of being undersold, for as one of the raw materials is worth less than nothing, other makers not possessing similar advantages may be working to a loss, while the makers of vitrified mortar will be reaping a profit.

The destructor requires but little attention. It is almost self-feeding, the material slips down the sloping bottom of the furnace, and the clinkers are easily withdrawn at the furnace mouths. The destructor furnaces are a series of cells. The cost of each cell for ironwork is about £80, to which the cost of brickwork must be added, The royalty is less than the cost of placing the refuse in a cart, or wheeling it across a road. The heat generated by the destructor furnishes power for grinding the mortar and for other purposes to be described hereafter. Each cell deals with 140 cwts. per day. By this mode of treatment the solid mineral refuse is absolutely got rid of, without injury to contemporaries or to posterity. No danger is to be apprehended from the spread of diseases, no accumulations remain, and that which was an incumbrance becomes a marketable commodity. It remains to be added that at Manchester the difference between cost and sale price leaves the corporation a profit on the trade of mortar making.

Having disposed of the mineral solid refuse, let me call your attention to the vegetable solid refuse. This consists of garbage, part of which is brought with the ashes and part is found in the pails. It includes the sweeping of the markets, also straw, shavings, rags, sacks, and an endless assortment of minor articles. To destroy absolutely these things would be wasteful, as they constitute the raw material out of which is made one of the most valuable substances for a Sanitary Committee. I allude to charcoal. A portion of the cinders before referred to, as food for the destructor, presents the needful fuel; and all that is required is a form of apparatus that shall, without much labor, and without producing any offensive odor, convert the garbage into charcoal. Condemned food, stale fruit and vegetables, are readily disposed of by the carbonizer. Sweepings of paved streets contain much vegetable matter, portions of hay and straw, horse-droppings, etc. These are readily carbonized, and the charcoal thus produced, together with that from the more exclusively vegetable matter before adverted to, is most valuable as a deodorant.

Having alluded to the great value of the charcoal thus produced, as a deodorizer, he said: When street sweepings are ground up with a certain portion of clay, and carbonized, they produce a charcoal of active power, and so little friable in its nature as to make an excellent filter bed. This form of filter is used by various dyers at the present time, and the process also. The carbonization of street-sweepings is the subject of patents held by the Universal Sewage Company.

The carbonizer, like the destructor, is composed of a series of cells, each of which deals with 50 cwts. of garbage per day. You have now been so good as to traverse with me the first of our three divisions—viz., the treatment of dry refuse, and we have converted it into mortar and charcoal. We will now briefly consider the substances that must be removed by water transport—

a. They consist of the involuntary supply.

b. Of the voluntary supply from dwelling houses.

c. Of the voluntary supply from other places.

The involuntary supply consists of the rain water that finds its way into to the rivers, of natural springs and leakage from the water supply.

These are all natural feeders of rivers; the forme two would exist if the town were absent, and the latter is no source of contamination. So far, then, as these are concerned, there is little that even the fastidious may complain of.

The voluntary supply from domestic sources consists of water used for washing and culinary purposes As the impurity from these sources consists mainly of soap and fat, and very little of nitrogenous matters, it is evident that, were the contents of the sewers confined to those substances, a very moderate treatment, either by precipitation or infiltration, would suffice to render the water fitted to enter streams.

That which enters the rivers from manufactories consists largely of dye-stained water, from which, as we have seen, the color may easily be discharged. From many works the water from the condensers of steam engines is simply raised in temperature.

Besides these there are some fluids which, when untreated, are unfit for discharge into streams. Thus it appears that the liquids that must of necessity find their way into rivers do little to pollute them, and may be rendered pure by a moderate treatment.

We have only now to consider the third class of this refuse—viz., the substances that may be waterborne, but which also may be excluded from sewers.

These are manifestly the contents of water-closets, and the drainings of public urinals, cesspools, and stables. These substances are all highly offensive. They are the vehicles for the spread of cholera and enteric or typhoid fever. They are the substances which generate poisonous river gases. They are those which pollute streams, and until the organic matter be decomposed they are dangerous to health. Even when the decomposition has been effected, and the nitrogen has associated itself with oxygen, so that it is found in the form of nitrates and nitrites, the mind still revolts at the introduction of human refuse, even so decomposed, into potable water.

Whilst sewers charged with these offensive and dangerous matters are unfitted to be discharged into rivers, they are at least as objectionable to the inhabitants of the town.

Sewers so charged are contrivances for the elimination of sewer gases, and these readily find their way into dwelling houses through imperfectly trapped drains. This, however, is not the whole source of mischief; the poison will find its way into dwellings through porous soils.

The death of Prince Albert at Windsor, and the alarming attack of enteric fever which the Prince of Wales contracted at Scarborough, show that those in the most exalted stations are not safe from the danger of sewer gases.

The modern system of dealing with sewers would be amusing, were it not so serious a subject. In order to conceal the sewage and escape the offensive effluvia, we convey it away in costly underground closed sewers and as by these means we have not hindered the production of sewer gases, which will force their way into dwellings if not suffered to escape elsewhere, ventilators are attached here and there to ensure the discharge of the poison into the open air.

Let it be noted that when soluble organic matter is once mingled with much water it cannot be extracted by any method of precipitation, and even when applied on irrigation farms only a portion remains. Nor should it be forgotten that the substances which are innocent in sewers are valueless out of them, whereas the very substances which are so objectionable in sewers and rivers possess a considerable value when isolated and concentrated.

Unless, then, there should seem to be some great difficulty, practical or financial, it would seem to be a self-evident proposition that "the best or simplest method to make sewers innocous is keep them innocuous." This leads us to the pail system. Even where this method is adopted without the improvements which experience has suggested, it presents a natural, sensible, simple, and effective mode of removing the offensive material. The improvements referred to are—1. That the pails should be thoroughly cleansed and purified before being replaced. 2. That each closet shall be supplied with a little charcoal. 3. That the pails sould be changed frequently. 4. That the pails shall be carried away in a closed van of wrought iron that should be absolutely steam-tight, or rather odor-tight. The importance of this will be appreciated by those who have stood in the wake of one of the ordinary vans. The pails may be closed with rubber-packed lids, which are supposed to be tight; but so long as here and there a pail leaks there is a trickling of offensive matter along the street, and a waft of sickening odor that marks the track of the van. Yet it is as easy, with proper appliances, to restrain the odor within the van as the scent within a vinaigrette, or the ammonia in a bottle of smelling salts. Such a van, possessing also minor advantages, which I will not trouble you with, we have devised.

We see, then, how the closets can be preserved sweet, and how the material can be transported to the depôt without a trace of nuisance. Let me here introduce a paradox. The dirtier the process, the greater the cleanliness needed. Not only should vans and harness be kept clean, but the men employed shou'd be clean in their persons and dress also. Each man might wear a glazed hat, and have daily supplied him a clean convas jacket, and a dark, but clean apron to protect his trousers. Having taken the fæcal matter to the depôt, the mode of disposal of it must now be considered. Human urine is well known to be the most valuable manure existing, but this valuable material is diluted with 30 times its weight of water. The removal of this water is the object sought, and the difficulties are so great as to have been considered by Mr. Rawlinson and others insuperable.

The odor from highly-heated urine is most offensive. Heat decomposes urea and drives off ammonia, and this valuable alkali is volatile at very low temperatures.

Yet the problem has been solved. No offensive odor whatever, and not even the faintest odor of fœcal matter or urine escape during the operation. Not a particle of ammonia is lost. The apparatus is not an untried one, but has been largely used during the last ten years in the concentration of cane juice. The process requires no chemicals and no skilled attendance. The concentration is effected in the concretor.

By this means nearly all the water is removed, and the already existing ammonia is fixed by the sulphurous acid in the gases from the destructors. As the process is simple, and the heat is furnished, as it were, gratis, it is not wonderful that the concentration is effected economically. This concentrated matter is named water charcoal, and forms a really valuable manure.—*London Journal of Gas Lighting.*

Gas-Light Intelligence.

United States.

Monmouth, Ills., is now lighted by gas.

Gas in Brazil.—Eleven cities in Brazil are now lighted with gas, while in five more cities it is being introduced.

The Joliet, Ill., Penitentiary is now being lighted by naptha gas. It is said to make a soft, rich light, at two-thirds the cost of ordinary gas.

Improving a Gas Works.—The gas works in Greenville, Mich., have been improved at an expense of about $20,000.

Petroleum Gas Works.—It is reported that a petroleum gas works company will be established at Westboro, Mass., with a capital of $10,000.

Removal of Gasoline Lamps.—The City Council of Sacksonville, Ills., has ordered the removal of gasoline lamps and the substitution of gas therefor.

Improvement in Lighting Streets.—The City Council of Dayton, Ohio, gives notice through its President, of its decision to improve several of the streets in that city, by lighting with gas.

Assessment.—In the assessment roll of persona property in San Francisco, the Spring Valley Company heads the list, being assessed $7,0000,000, and the San Francisco Gas Light Company comes next with $6,000,000.

Lighting a Canal.—It is reported that the St. Catharines, Ont., Gas Company are about completing arrangements with the Canadian Government for the lighting of the new canal between Thornold and Port Dalhousie.

Extension of Time Granted.—At a meeting of the Board of Trustees of Lake, Ills., on the 4inst., the application of Mr. Irus Coy, for an extension of the time within which labor on the new gas works is to be commenced, was granted.

Delay in Lightifg a Town.—No steps have, as yet been taken by the Council of Munich, Ind., towards supplying that city with gas, although the citizens at an election, held a considerable time since, voted, by a large majority, in favor of the improvement.

The Largest Single-Lift Gasholder.—The Boston gaslight company have the largest ingle-lift gasometer in the world--203 feet in diameter, 40 feet high, and with a capacity of 1,250,000 feet. But it has not been used since it was built, a year and a half ago.—*Engineering News.*

Extensive Additions to a Gas Works.—The Aurora (Ohio) Gas Company are, during the present summer, making extensive additions to their Works. They are putting in a new and much larger receiver for gas, and they are also largely extending their gas mains preparatory to lighting the streets both in the First and Third Wards.

A New Gas Company.—The new gas company at Newton, Mass., talked of for some time past promises to be in operation soon. It is proposed to start with a capital of $50,000, and introduce gas in the First, Second and Seventh Wards. The gas will be made from petroleum by Wren's method, and will be furnished to consumers at the rate of $2 per 1000 feet. Books will be immediately opened for subscriptions for stock.—*Engineering News.*

Governing Proposals for Furnishing Gas.—The City Council of Hamilton, Ohio, at their meeting on the 23d ultimo, adopted plans and specifications to govern proposals for furnishing that City with gas, both for public and private consumption. The contract is to commence June 3d, 1878, and to be for a period of ten years, the bond required from the party, or parties, to whom the contract may be awarded being in the sum of $25,000, bondsmen to be residents of the State of Ohio. In case the contractor erects new works, the city reserves the right to designate the locality where such works are to be erected. We do not learn that any limit has been set as to the time up to which proposals will be received.

Introduction of Gas at Clifton, Ohio.—The Council of Clifton, Ohio, at their meeting on the 30th ultimo, by an unanimous vote, passed an ordinance for the introduction of gas. It is said that the work of laying the mains will be pushed with vigor and be completed within the next sixty days. The ordinance as passed, gives to the Cincinnati Gaslight and Coke Company the exclusive right to lay mains in the streets for ten years, "and thereafter so long as the said company shall supply gas to the citizens of Cincinnati, or until said villiage shall be annexed to and become a part of Cincinnati," and also contains provisions for the emergencies of annexation to Cincinnati and the purchase of the gas works by that city.

The Providence Gas Company.—The annual meeting of the stockholders of the Providence Gas Company was held at the office of the Company, in Market square, yesterday afternoon, at 1 o'clock p. m.

The annual report of the directors to the stockholders was read and ordered to be placed on file.

The following named gentlemen were duly elected directors of the corporation for the ensuing year, viz.: Truman Beckwith, William Goddard, William Whittaker, Amos C. Barstow, Charles E. Paine, A. B. Slater, Royal C. Taft, Edward Pearce, Jr., and Jesse Metcalf.

At a meeting of the directors, after the annual meeting of the stockholders, the organization was completed by the election of officers, as follows: *President*—Amos C. Barstow, *Vice President*—Wm. Goddard *Treasurer and Secretary*—A. B. Slater.

Great Britain.

Proposals to Purchase a Gas Works.—The Liverpool, Eng., Town Council recently discussed a proposal to negotiate with the gas company for the purchase of their works for the Municipality, but the Council would only sanction a preliminary interview. One argument against the proposed acquisition is the probability that gas will be superseded by the electric light to a considerable extent.

Water Supply Items.

Loss of Water.—It is asserted that Boston loses 16 per cent. of its water supply from bad plumbing.

Erection of Water Works.—Dixon, Ill., is considering the question of erecting water works.

A Good Request.—A generous ice company at New London, Conn., is begging that city to place suitable water tanks in the various streets and let the company keep them full of ice, free of charge.

Opposition to a Water Works.—There is very strong opposition to the water works scheme proposed in Petersburgh, Ont.

Award of Contract.—The Boston water board on the 10th August, awarded the contract for building dam No. 3 of the Sudbury river water works to J. E. Fuller and V. Nash (Fuller & Nash of Worcester), whose bid was $69,040. There were twenty-two bid

ders in all, and Michael Kiernan & Co. were the lowest bidders, but withdrew.

BREAK-DOWN OF A PUMPING ENGINE.—Providence, R. I., seems to be in a fix over the break-down of its big pumping engine, through its being placed over a bed of quicksand. The building still continues to settle, and it is understood that the makers of the engine decline to repair and guarantee it, and one paper calls the $250,000 building and engine "practical wrecks."

THE LARGEST WATER TAKER IN BOSTON.—The Boston and Albany Railroad consumed last year over 36,000,000 gallons. The Boston Gas-Light Company took over 34,000,000, the Standard Sugar Refinery 31,700,000, the Continental Sugar Refinery nearly 26,000,000, the Norway Iron Works 22,600,000, and the Old Colony and Newport Railroad 22,200,000. Among the hotels the Revere House took 11,600,000, the Parker House 1,300,080, and the Tremont House 9,100,000.

RECEIPTS OF THE BOSTON WATER WORKS.—The total receipts of the Boston Water Works for the year ending April 30th, 1877, were $1,096,802, of which $1,029,000 was from sales of water. The total expenditures were $1,024,461, of which $202,902 was for current expenses, and $747,624 was for interest and premium on the water debt. The excess of receipts over expenditures was $72,340. The total amount charged to construction during the year was $2,129,779. It will be seen from this that even with a water debt of $12,000,000 the Boston Water Works are made to yield an income sufficient to pay the interest on the debt, their operating expenses, and afford a surplus of $72,000 a year for the reduction of the debt.

Loss of Lives and Money in the Wars of the Last Twenty-Five Years, 1852-77.

The following statement appears in a contemporary, and is, perhaps, as near the truth as it is possible to come in so large a subject :—

The following tables are carefully compiled from the official statistics of the various nations concerned, and include, in addition to the troops slain, a portion of the deaths occasioned by the ravages of was amongst the civil population.—

(I.) LIVES LOST, 1852-77.—Killed in Battle, or Died of Wounds and Disease.

	Persons.
Crimean War	750,000
Italian War (1859)	45,000
War of Schleswig-Holstein	3,000
American Civil War—The North, 280,000; The South, 520.000	800,000
War between Prussia, Austria, and Italy in 1866	45,000
Expeditions to Mexico, Cochin China, Morocco, Paraguay, &c.	65,000
Franco-German War 1870 and 1871 France 155,000; Germany, 60,000	215,000
Turkish Massacres of Christians in Bulgaria, Armenia, &c., 1876-77.	25,000
Total	1,948,000

(II.) COST, 2852-77.

Crimean War	£340,000,000
Italian War of 1859	60,000,000
American Civil War—The North £940,000,000; The South, 460,000,000	1,400,000,000
Schleswig-Holstein War	7,000000
Austrian and Prussian War, 1866	66,000,000
Expeditions to Mexico, Morocco, Paraguay, &c., (say only)	40,000,000
Franco-Prussian War	500,000,000
Total	£2,413,000,000

The loss of life is equal to about half the population of the whole metropolitan area; and we may vaguely imagine what would be the effect upon production and consumption of absolutely depopulating the whole of the West and North districts of London. The loss of £2,413,000,000 sterling of capital, is equal to about eight or ten years' revenue of all the Governments of Europe and North America. But a public revenue is applied in the payment of services, and the promotion of public works which are to a large extent useful. The £2,413,000,000 of money destroyed in war have been absolutely annihilated. Further, the fortresses, ships, artillery, &c., destroyed by war, have to be replaced by capital taken, over a series of years from productive purposes. The same remark applies to the pensions and rewards granted to maimed and disabled soldiers and sailors. —*Exchange.*

Prices of Gas Coals.

Prices of gas coals remain without material change.

Westmoreland	$5.50	$4.50)	at Baltimore.
Penn	5.50	4.50)	
Despard	5.35		
Marion	5.35		
Murphy Run	5.35		
Newburgh Orrel	5.35		
Ches. and Ohio RR. Caking Coal	5.25		
Block House	4.50	1.75)	Gold f. o. b. at Mines.
Glace Bay	4.25	1.60	
International	4.25	1.60)	
Clover Hill	4.00		
Cannelton Cannel	10 00		
Peytona	10.00		

Since our last issue there has been a partial resumption of shipments from the Westmoreland and Penn region, sufficient to meet the necessities of some of the gas companies who had allowed their stock to run low. There appears to exist no ground now for any anxiety relative to supplies from the Pennsylvania mines for the rest of the season. There is, however, an under-current of dissatisfaction among the miners generally, which will require the exercise of the clearest judgment to remove. The frequency of strikes in our domestic mining districts has tended to unsettle confidence in the fulfilment of contracts, and the sooner this is restored, the better it will be for all parties interested. The interference of the Railroad Corporations with the coal companies in the details of marketing coal, has been the cause of much of the present depression in the mining regions.

Owners of coal properties find themselves hampered in their operations by the supervision of railroad freight agents over all the details of price at which coal is sold, markets to which it is sent, and other matters which have heretofore been considered as solely at the discretion of the coal operator. Any adjustment of the present difficulties which does not result in freeing coal companies from this interference with their private affairs, and compel railroad companies to transport coal for all producers at equivalent freight rates, will fail in producing any permanent relief from the present unsatisfactory state of this important trade.

But little is doing in English gas coal we note one arrival of Newcastle, contracted for early in Spring—at about $4 gold.

Shipments of Provincial coal show a large increase over last year. The prices above quoted represent the cost of these coals delivered at New York and New England.

Gas Stocks.

Quotations by W. B. Scott & Co., Bankers,

24 PINE STREET, NEW YORK CITY.

SEPTEMBER 17, 1877.

☞ All communications will receive particular attention

Gas. Co.'s of N. Y. City.

	Capital.	*Par.*	*Bid.*	*Asked.*
Central, Westchester	466,000	50	90	95
Harlem	$1,850,000	50	95	97
Manhattan	4,000,600	50	205	210
Metropolitan	2,500,000	100	128	132
" Scrip	$1,000,000	...	100	103
" Bonds	500,000	1000	92	94
Mutual	5,000,000	100	95	97
" Bonds, gold.	900,000	1000	105	—
Municipal	1,000,000	100	70	80
New York	4,000,000	100	125	123
Suburban, W'stch'str	390,000	50	—	100

Gas Co.'s of Brooklyn.

Brooklyn	2,000,000	25	150	160
Citizens	1,200,000	20	—	75
" Scrip	320,000	1000	95	97½
Peoples	',000,000	10	40	45
" Bonds	$ 325,000	...	—	95
" Scrip	300,000	...	75	80
Metropolitan	1,000,000	100	65	70
Nassau	1,000,000	25	80	85
" Ctfs.	700,000	1000	96	98
Williamsburgh	1,000,000	50	115	120
" Scrip		...	100	103
Union Co. E N. Y.		25	—	50

Out of Town Gas Companies.

Bath, Maine	70,000	100		
Buffalo Mutual, N. Y	750,000	100	65	70
" Bonds	200,000	1000	95	100
Baltimore, Md	2,000,000	100	134	134
" Ctfs., gold	1,000,000		106	110
Bayonne, N. J		100		90
Brockport, N. Y	25,000	100	...	80
Citizens, Newark	918,000	50	100	105
" " Bds.	124,000	—	—	—
Cincinnati G & C Co				190
Derby of Conn	160,000	100	60	80
East Boston, Mass.		25	132	—
Fort Wayne, Ind		100	...	—
Hannibal, Mo	100,000	100	95	100
Hartford, Conn	700,000	25	184	186
Hempstead, L I	25,000	100	...	—
Jersey City	386,000	20	155	160
Jamaica, L. I	25,000	100	...	—
Jacksonville, Ill	120,000	50	82	...
Lewistown, Maine	400,000	100	50	85
Lima, Ohi'o	60,000	100	—	...
Bonds	30,000		90	
Laclede, St Louis Mo.		100	100	150
Long Branch	1,200,000	20	40	50
Peoples, Jersey City		...	120	125
Peoples of Albany	650,000	100	—	20
" Bonds	350,000	1000	—	-
Peoples of Baltimore		25	76	—
" Bonds			106	—
Perth Amboy		25	—	95
Rochester, N. Y		100	50	60
Richmond Co., S. I.	300,000	...	—	95
Woonsocket, R. I	150,000	100	100	...
Halifax N. S	400,000	40	148	150
Hamilton, Ontario	150,000	40	117½	
San Francisco Gas-Co., S. Fr'isco Cal.			111	112
St. Louis, Missouri	600,000	50	73	75
Stillwater, Minn	50,000	50	—	26
Saugerties, N. Y	15,000	100	95	100
Troy, Citizens	600,000	100	—	60
Toledo, Ohio			95	97½

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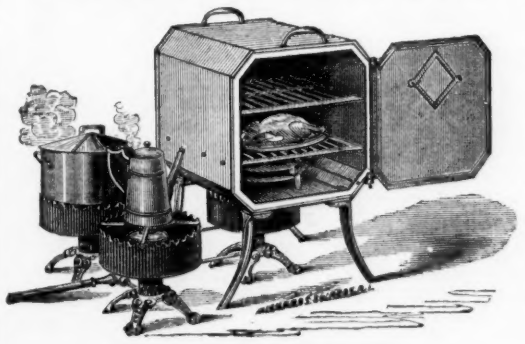

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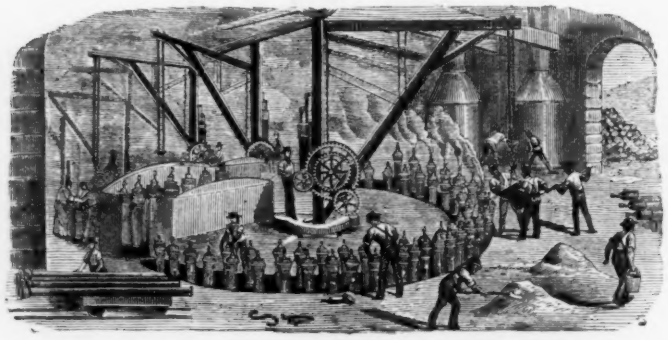

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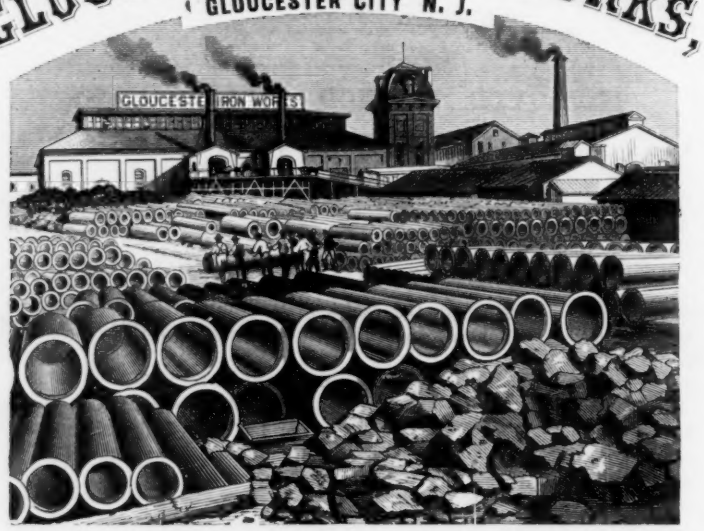

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HEAVY AND LIGHT CASTINGS OF ALL KINDS.

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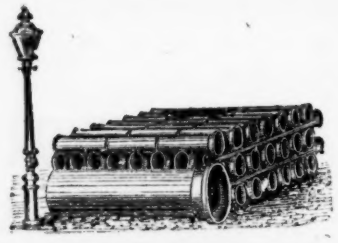

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Of Pittsburgh, Pa.

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Orrel Coal Company,

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Company's Office, No. 52 S. Gay Street, Baltimore, Md.
C. OLIVER O'DONNELL, Pres't. CHAS. MACKALL, Sec'y.
CHAS. W. HAYS, Agent in New York, Room 7, Trinity Building, 111 Broadway.

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It has been for many years very extensively used by various Gas Companies in the United States, and we beg to refer to the Manhattan, Metropolitan, and New York Gas Light Companies of New York; the Brooklyn and Citizen's Gas Light Companies of Brooklyn, N. Y.; the Baltimore Gas Light Company of Baltimore, Md., and the Providence Gas Light Company, Providence, R. I.

Best dry coals shipped from Locust Point, wharves, and prompt attention given to orders for chartering of vessels.
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To Gas Light Companies throughout the country.
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Mines in Harrison County, West Virginia.
Wharves Locust Point, } Baltimore.
Company's Office, 15 German St., }

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Company's Office, 52 S. Gay St., Baltimore.
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SHIPPING POINT—Baltimore, Md.

This coal yields 10,000 cubic feet of Gas with an illuminating power of over 16 candles. Forty bushels of very superior Coke, with little Ash and scarcely any clinker 94-1y

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GAS COALS.

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PENN GAS COAL COMPANY
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acknowledged to be the most valuable ENRICHER produced in this country, a gross ton yielding 10,000 cubic feet of GAS of 64·54 CANDLE POWER; COKE 32 bushels, of good quality.

CANNELTON CAKING COAL.
MAXIMUM YIELD, 5.06 cubic feet of Gas per pound of Coal—A yield of 4·78 cubic feet per lb.—gave 16 14-100 Candle-Power.
COKE, of very fine quality—1453 pounds produced from one ton of coal.

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The facilities of the WAVERLY COMPANY are unsurpassed by those of any other Company on the Youghiogheny.

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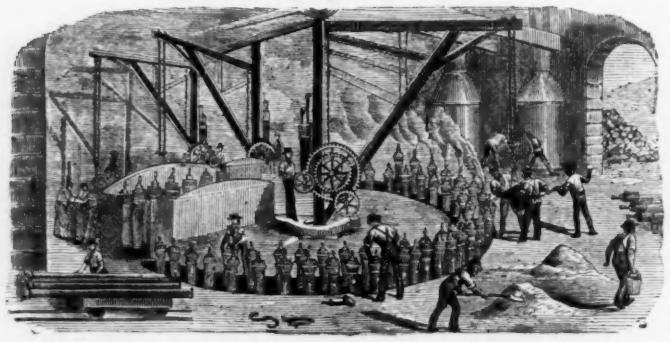

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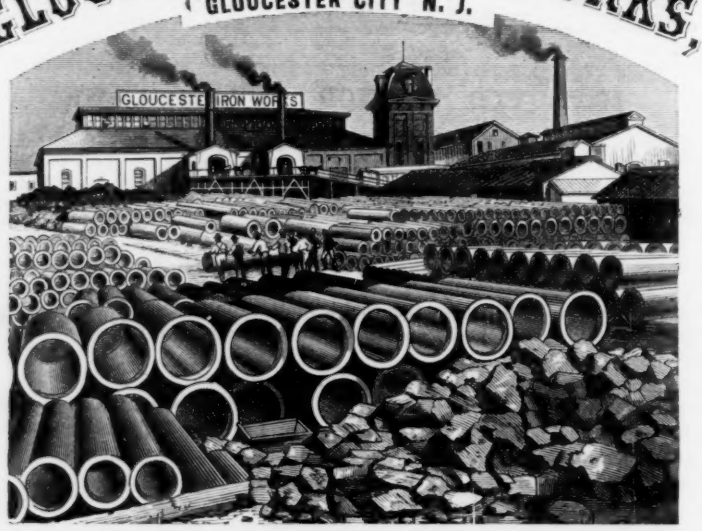

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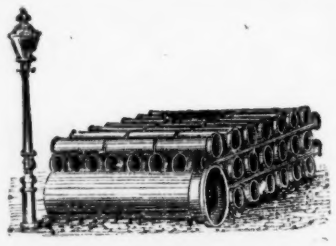

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Best dry coals shipped from Locust Point, wharves, and prompt attention given to orders for chartering of vessels.

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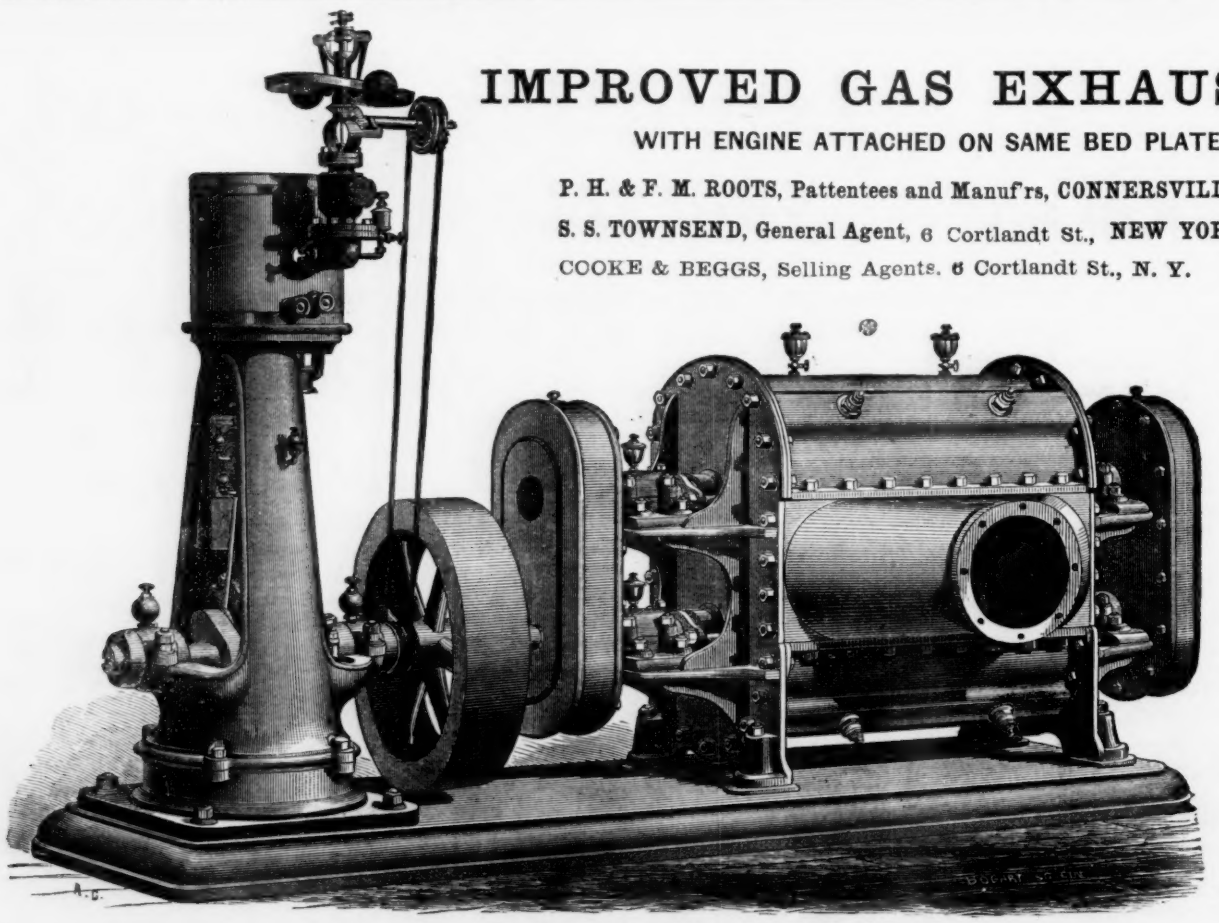

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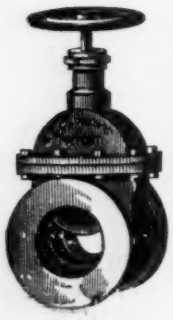

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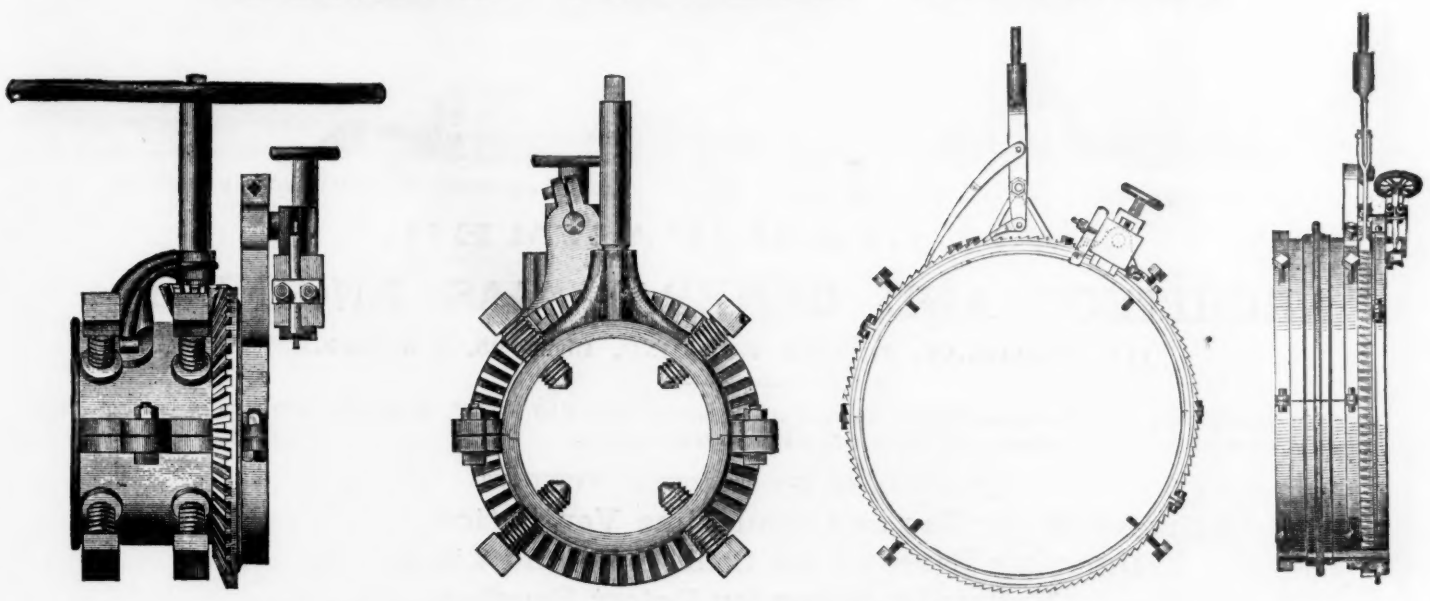

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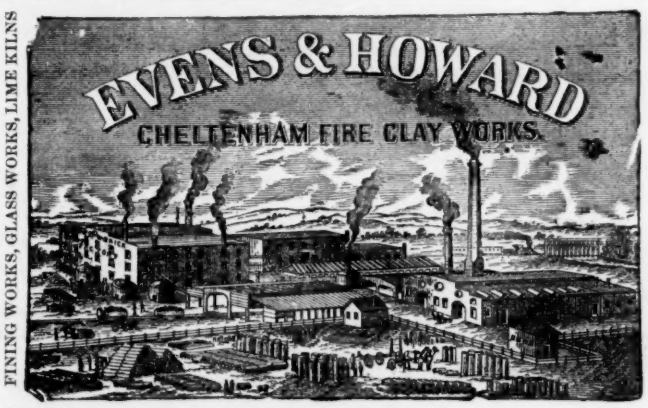

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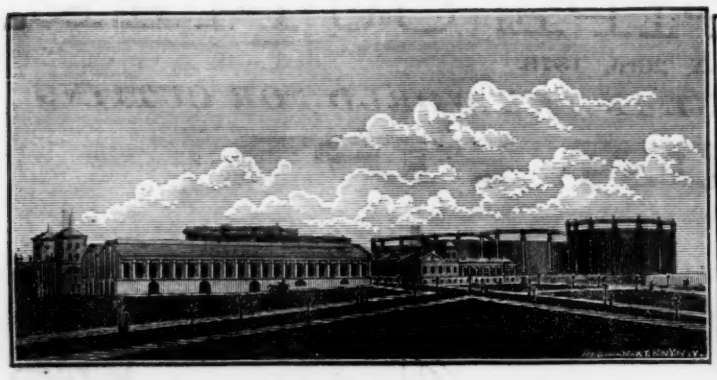

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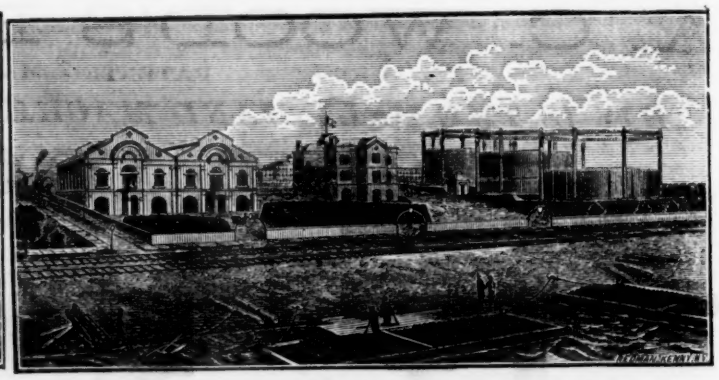

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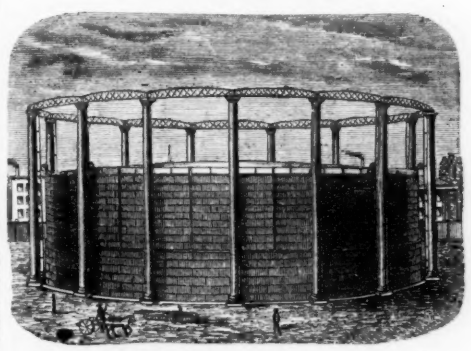

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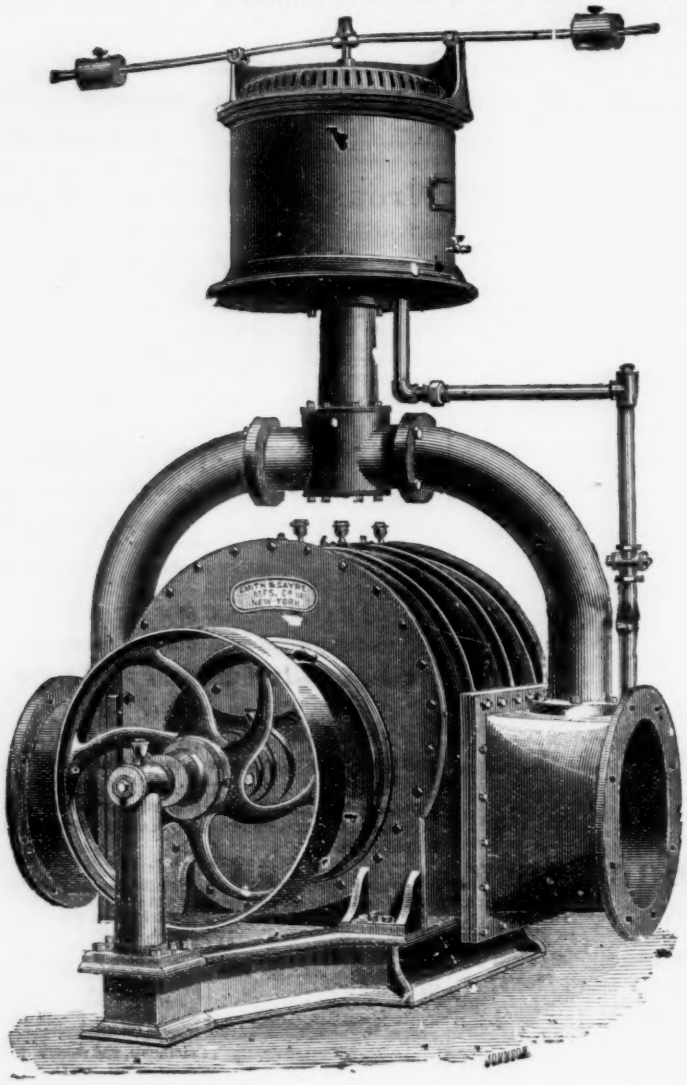

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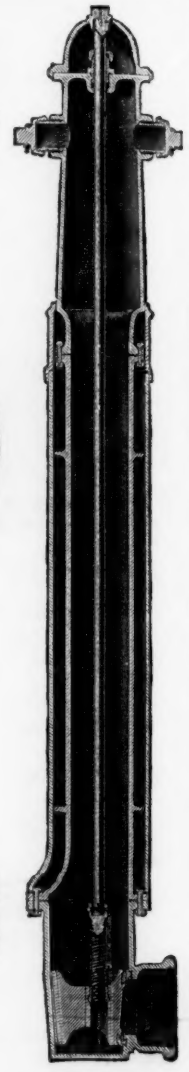

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